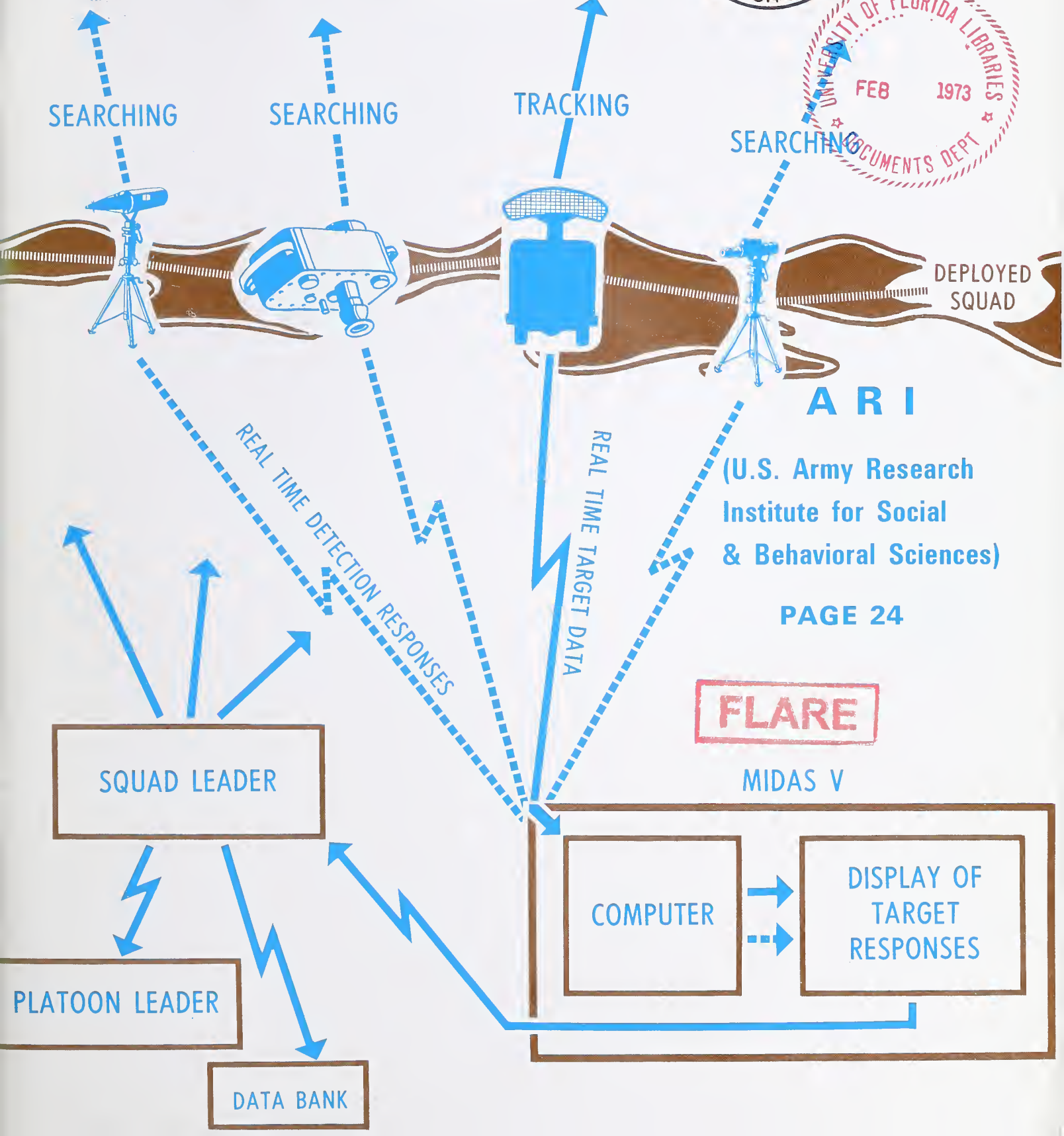
RESEARCH AND DEVELOPMENT

December 1972



ARI

(U.S. Army Research Institute for Social & Behavioral Sciences)

PAGE 24

SPEAKING ON . . .

Increasing Defense Electronics Productivity

Director of Defense Research and Engineering Dr. John S. Foster Jr., in a recent address before the Armed Forces Communications Association meeting in Washington, D.C., discussed one of the critical problems vexing R&D leaders—inflation effects and how to do more with less money, as follows.

★ ★ ★

Today, I'd like to talk about a serious national security problem—a 3-way dilemma that faces us, and then to describe a possible solution which we are trying—a solution I am convinced can work.

First, very briefly, the dilemma: It has three elements—cost, money and need:

• First, is Defense costs. Over the past 20 years the cost of defense systems and manpower has been rising at more than five times the rate of inflation.

• The second element is money. The extra money to pay for those rising costs is not available; all of the growth in the GNP over this same time period has gone into nondefense sectors. This trend will continue. As a consequence, we have been reducing equipment numbers to a dangerous extent to hold within the total dollar limits. For instance, in the 10-year period from 1956 to 1965 we bought an average of 1,800 fixed-wing aircraft per year—in FY 73 we will buy 383 aircraft. Our inventory is getting smaller and older.

• The third element of the dilemma is need. The need for national security forces—forces for deterrence, and forces for battle, if necessary—is growing with the growing size and sophistication of the arms of potential adversaries. Our near-term needs, in fact, appear to cost more than the foreseeable funds.

To see this clearly, compare the likely DoD budget projections with the expected cost of acquiring and maintaining a force structure competitive in quality and numbers—that is, a projection of currently available and planned weapons. We find a significant dollar shortage in each mission area.

For example, in tactical aircraft, even with the introduction of the relatively inexpensive AX aircraft, we could require approximately $4.2 billion annually by 1980 for procurement, whereas we anticipate that only $2.4 billion may be "available." Similar outlooks exist in land vehicles, strategic weapons, and so forth.

Thus, if we are to be able to live within our resources and at the same time provide an effective defense, we must, in my view, find a way to increase our productivity by about 2 to 1.

This means improving our *total combat performance*—not just "higher, faster and farther." Total effectiveness includes quantity, quality and availability, all for an affordable dollar level.

But how do we get more for less? That is what I want to talk about today, because your responsibility is for Armed Forces communications and electronics, an area in which I believe that new approaches to productivity are necessary and can work.

As I'm sure this audience realizes, communications and electronics consume more than one-third of our total DoD procurement and support dollars.

In this area, we have two major problems: first, high and continuously rising costs; and second, poor field reliability which affects both equipment availability and support costs. In the past 20 years the cost of military electronics equipment has grown at an average of more than 25 percent yearly, with each new design costing more than its predecessor. Also, while electronic parts reliability has improved, the reliability of full military electronic systems has remained low. Yes, we get more functions and more performance, but we pay much more money, and we don't get better reliability. The shortfalls are hurting our defense.

For comparison, let's look at productivity in the commercial world. There the manufacturers have been eminently successful in using technological advances to reduce cost and increase reliability while holding or improving performance.

For example, electronic desk calculators a few years ago cost about $1,500; now some cost about $100. The latest anticipated price I am aware of is $39. Or, portable transistorized radios: in 1950 they cost between $25 and $150; now they cost between $5 and $25 for a comparable or improved level of performance, and they are smaller and less costly to operate as well.

There are those who say that commercial experience is not relevant to military electronics because military needs and combat conditions are inherently different. This is a theory which will not stand up under scrutiny.

The differences are not so gross, and the assumption that they are too often leads to designs that meet fancy technical requirements in the laboratory but fail in the field. The field forces don't get the best; they get a short mean-time-to-failure and a long wait for repair; and, because of the high price of state-of-the-art equipment, they don't get enough equipment to meet the military need.

We can and we must draw more heavily on commercial experience and move in their direction in design objectives, technical requirements, management perspectives, engineering design, data, and field support.

Now, what can the Defense establishment do to move more in this direction? I believe that to acquire and maintain communications and electronics equipment in the future, in the quantities the Services need, three moves will take us to greater productivity: (1) design-to-a-price, (2) greater standardization, (3) greater supplier responsibility for field reliability.

To begin with, let me summarize the design-to-a-price concept. First, we will set a price-per-copy that is compatible with both the minimum required military performance and with what we can afford to pay for the number we need.

Second, we will accept, under that ceiling, only quality products. Products that are just cheap aren't acceptable. Military needs must be met—or we will *not* buy the equipment.

Third, we are willing to pay more in time and dollars in the R&D phase in order to assure achieving the desired unit production price and support costs.

Fourth, we will be writing "functional specifications" rather than detailed design specifications. In this way, the designers will be given the flexibility to find solutions leading to low cost and high field reliability.

Fifth, we—and the contractors—will acquire enough experience, in the early phases to know that the desired product can be acquired for the established production price.

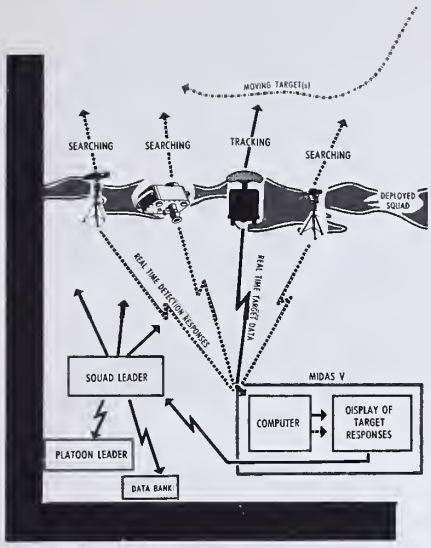
Sixth, we will scrub the technical requirements and statement of work to reduce the number of military specifications and the government data required.

Let me emphasize that designing-to-a-price is not, as some people have asserted, a move back toward total package procurement. In fact, the two approaches are just about opposite.

Total package procurement required one decision to develop and produce specified numbers of a system to specified performance, cost, and time limits.

The new policies emphasize incremental acquisition and early

(Continued on page 40)



ABOUT THE COVER:

Experimentation by members of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) field unit at Fort Ord, Calif., (Hunter-Liggett site) is depicted on the front cover. This unit has the capability, with the help of the MIDAS V (Multi-Input Data Acquisition System developed by ARI), of investigating a number of squad or platoon problems where target information must be interpreted and relayed to platoon and squad leaders or data banks. This research supports selection and training of personnel, basis of equipment issue, method of work, and decision.

In the schematic, a staff member of ARI continuously tracks a moving target; the position data are electronically entered into the MIDAS V system. Simultaneously, soldier operators on different devices (Starlight Scope, Thermal Viewer, etc.) search for targets. When they make a detection response (either true or false), the information is recorded and displayed, in real time.

Photos on the back cover depict a variety, but still only a sample, of military operations—actual or simulated—aiding ARI research accomplishments or projected human factors research.

Editor . . . . . **Clarence T. Smith**
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FEATURES

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Selective Scanner . . .

NBS Develops Device for Monitoring Pollution

Precise measurement of the size distributian af particulate matter in the atmasphere is reparted passible with a device recently developed by the National Bureau af Standards (NBS), U.S. Department of Cammerce.

The research was part af the NBS Measures for Air Quality Program in support of the Enviranmental Protectian Agency.

Intended primarily far air pollution manitaring, the device may find wide applicatian in general aerosol studies—claud physics, fuel atamization, paint spraying, and smake characterization, for example—and in studies af the physiolagical effects af particulates. This has long been a primary area of research at the Army's Edgewaad (Md.) Arsenal.

Developed by Dr. C. C. Gravatt, Palymers Division, NBS, the apparatus utilizes simultaneaus measurement of particle light intensity emitted from twa angles. Applicatian af a twin-angle respanse makes size determinatian largely independent af the index af refractian af the particle, thereby minimizing errars.

The system functians by blawing the air sample thraugh a light beam fram a cantinuaus wave laser. Scattered light fram individual particles is then gathered by separate annular fiber aptic rings pasitioned at 5 and 10 degrees to the laser axis. Light is detected by phatamultipliers and an autput pulse is generated for each particle in relationship ta its size.

Additianially, the device can pravide infarmatian an the shape and chemical campasitian of a particle and its total caunt per second. Classification af substances inta water, silicate, carbon ar metallic-like content is passible. Knowledge of shape, such as in asbestas, may be useful in discavery af potential cancer-inducing agents, researchers believe.

2 Firms Gain Contracts for V/STOL Designs

Selectian af twa firms far cantract awards has initiated the first af a 2-phase joint program far the design, fabrication and test of two vertical take-aff and landing (V/STOL) tilt-rator research aircraft.

Fixed-price design cantracts far $500,000 each were awarded Oct. 20 ta the Bell Helicopter Ca. and Baeing Ca. The program is jaintly spansared by the National Aeranautics and Space Administration and the U.S. Army. Fallawing completion of this phase, one firm will be selected ta build and test twa research tilt-rator aircraft.

This propulsion system accomplishes direct vertical take-off and landing and farward flight utilizing precisely maneuvered wing tip rators. The V/STOL concept is expected ta pravide a quiet, versatile system for bath military and cammercial use.

Mobile Team Trains Medics for MUST System

Features af the Medical Unit Self-Cantained Transportable Hospital (MUST) are being explained and demanstrated ta Army medical persannel at stateside pasts by a tauring Department af the Army (DA) team.

The team is going ta all surgical and evacuatian haspital units in the Cantinental Army Cammand ta train persannel. The MUST units, which have demanstrated their merit in Southeast Asia canflict, are replacing the hospital field tents the Army has traditionally used in cambat situatians.

Inflatables, expandables, and pawer packs comprise the MUST system. Inflatable units can be joined ta farm various hospital wards, clinics and labaratories, and when blown up are shaped much like the famed Quanset huts.

Both the inflatables and expandables attach to power packs that provide the life suppart systems needed to run hospitals. The pawer packs have praved functional at minus 65 degrees to 125 degrees F. above zera.

WSMR Selected as SRAM Evaluation Site

White Sands Missile Range (WSMR), N. Mex., has been selected as the site for the first fallow-an aperatianal test and evaluation af the AGM-69A, Short Range Attack Missile (SRAM).

SRAM separates from Air Force FB-111 jet.

The U.S. Air Force Strategic Air Cammand (SAC) has established a test affice ta caardinate and canduct the live missile firings.

The fallaw-on evaluatian marks the third phase af testing the SRAM weapan system. The first twa develapmental phases were alsa canducted at WSMR. Slated for testing are 34 SRAM missiles, which will be launched from SAC B-52G aircraft. Effectiveness af the system under simulated cambat canditians will be studied.

Canceived in the mid-1960s, the SRAM is designed to penetrate defenses fram high and low altitudes.

CDC Uses Lasers for Tactical Experiments

Laser pulses and sensars, cambined in a system called Direct Fire Simulatar, are taking the place af human observers and umpires in tactical experiments af the Combat Develapments Cammand (CDC) Experimentatian Command at Fart Ord, Calif.

This technique af "umpiring" thearetical (simulated) battles played a key role in adapting the TOW missile to a helicapter ta create the deadly tank-killer which was used sa effectively in recent Vietnam cambat actian.

Helicapter-TOW crews, recarding 47 airborne "kills" in places like Pleiku and Kantum, develaped their tactics an the cammand's "live chessbaard" at Hunter Liggett Military Reservatian sauth af Fort Ord.

Using the large gun laser (as compared with the man-portable system), the chappers gat their first "kill" data fram the sensars maunted on the real tanks they "attacked" on the Califarnia terrain. These tanks could fire back at the TOW-chappers—alsa with harmless laser beams.

Sensars ar detectors an tanks, helicopters and saldiers hit by a laser beam in the "battle" area set aff a smake, light or buzzer signal while reparting the time, place and patential damage to a computer which resets them for continued action.

Effluents Permits Authority Transferred to EPA

Authority to issue permits far the discharge of effluents inta navigatianal waters has been transferred fram the Army Corps af Engineers ta the Enviranmental Protectian Agency, under terms af the Federal Water Pallutian Contral Act af 1972.

Transfer of the applications files from the Carps ta the EPA is scheduled for completion by December. The Corps of Engineers has issued discharge permits under authority of the Refuse Act Permit pragram, and had pracessed 21,000 applicatians when the EPA taak aver the program. Final actian on the applicatians will be taken by the EPA.

The Corps af Engineers will cantinue ta pracess applications and issue permits for structures in navigable waters and far discharge of dredged ar fill materials in navigable waters at specific dispasal sites.

USASCS Adds Color to Television Education

Calar has been added ta educatianal clased circuit television at Fart Manmauth, N.J., with the installatian of twa studia calor praductian cameras and a film playback system at the U.S. Army Signal Center and Schaal.

Capable af transmitting calar film, the RCA TK-28 playback system is being used with twa RCA TK-44B calor cameras at the Educatianal Televisian Facility (ETV). Twa hundred receivers will be initially installed far calar receptian in classraams and staff faculty sectians.

The RV facility has been designated the CONARC (Cantinental Army Command) Calar Television Regianal Suppart Center. The Infantry Training Center at Fart Dix, N.J., and the Chaplain's Schaal at Fart Hamiltan, N.Y., also will be pravided praduction support.

The TV Divisian has the capability af transmitting pragramed material aver a 22-clased-circuit-channel system. Twa channels are reserved for the Instructianal Methads training at the Signal Schaal. The cable system carries live, taped or film pragraming ta mare than 700 receivers thraughaut the Signal Center and Schaal and Fart Manmauth areas.

Aberdeen Scientists Develop New Explosives

Twa new explasive campaunds develaped far use as a liquid ar a salid gun propellant ar a racket fuel are undergaing tests at Aberdeen Praving Ground, Md.

Develapmental wark was perfarmed by Alan C. Duckworth under the direction af Dr. Lester P. Kuhn, chief chemist at Aberdeen's Ballistic Research Laboratories.

Many nitragen campaunds are explosive. It was Dr. Kuhn's thaught that by using nitragen campounds from the azida graup he could cancentrate the well-knawn explasive effect.

Early tests indicate that the new campounds burn faster and at a lawer temperature than the traditional prapellants. Lower prapellant temperatures wauld tend ta pralang the lives af guns in which they are fired.

The new campounds can alsa be used in initiatars, ar chemicals that spark an explasive reaction. TNT, far example, heated in the absence of an initiatar, will merely melt. Traditional initiators such as the fulminates af the heavy metals tend ta be unstable.

Las Vegas Center Joins EPA Research Group

Faur National Enviranmental Research Centers have been designated by the Environmental Pratectian Agency, the mast recently selected being the Western Enviranmental Research Center, Las Vegas, Nev. This was established in 1959 as the Radiolagical Health Laboratary af the U.S. Public Health Service. Other National Enviranmental Research Centers are in Research Triangle Park, N.C., Carvallis, Ore., and Cincinnati, Ohia.

The Las Vegas center has throughaut its histary develaped and used new techniques far manitoring and sampling radiaactive pollutants in the environment. Currently, it maintains a fleet af 12 specialized aircraft used in the aerial remote sensing and sampling af air, water and terrestrial pollutian.

In a 2-year EPA natianal Eutrophicatian Control Program, the helicapters and fixed-wing aircraft are being used to determine the degree of eutrophicatian in abaut 1,200 lakes.

Army Engineers View Civil Works Program Impact

Under cangressional guidelines, the Army Carps of Engineers is giving careful attentian to any potential sacial, ecanamic and environmental impact af any new Civil Works prajects.

Section 122 af the River and Harbor and Flaod Control Act of 1970 provides guidelines supplementing the Natianal Enviranmental Palicy Act af 1969, which required a careful review of the effects ar impacts an the enviranment that wauld be created by any engineering praject.

Effect assessment, under the new guidance, parallels and is cancurrent with praject formulation, the pracess by which alternative means are develaped ta meet abjectives based on expressed needs. Outlined is the system far accamplishing this type af analysis within the planning pracess.

Effect assessment consists af the fallowing steps: identification of praject-caused economic, sacial, and enviranmental effects; quantitative and qualitative descriptian af the effects; evaluation to determine their significance and whether they are beneficial or adverse; and consideratian of measures to be taken in the event af significant project effects judged to be adverse.

NBS Finds New Value for Speed of Light

The speed af light has been determined more accurately than ever befare by scientists at the National Bureau af Standards, Baulder Laboratories, an agency of the U.S. Department af Cammerce, far tracking satellites and space vehicles.

Light travels at a velacity af 299,792.4562 kilameters per second, give or take 1.1 meter per second, they found. Translated as 186,282.3960 miles per secand, plus or minus 3.6 feet per secand, this is 100 times mare accurate than the value accepted far the past 15 years, which was 299,792.5 kilameters per secand.

Twa separate NBS experiments resulted in the new value. In ane, the frequency af a laser (a stabilized helium-nean laser operating in the infrared) was measured in terms of the cesium frequency standard. The secand experiment invalved the measurement of the wavelength of a similar laser in terms af the kryptan length standard. Multiplying the frequency by the wavelength gives the speed af light.

The speed af light is a canstant of nature symbolized by **c** found in many physical laws and experiments. All electromagnetic energy, whether low-frequency radia waves or high-frequency X-rays, travels through a vacuum (space) at this speed. According ta Einstein's thearies, **c** is the maximum speed attainable by anything.

Spin-off benefits af the accurate frequency and wavelength measurements made in space research open up passibilities far a whale new frequency range far telecammunications, an increase af 1000-fald overall the frequency bands presently utilized.

Manufacturers can achieve finer accuracy in instrument manufacture and ather precisian equipment. Environmental scientists will find that improved frequency contral af precisely tuned lasers will permit new pragress in the study af minute quantities af pollutants.

AADCOM Gets First Improved Hawk System

Assignment of the Impraved Hawk Missile System ta the first Army unit ta receive it in Germany was marked by the 32d Army Air Defense Command (AADCOM) in ceremonies at Kaiserslautern. Selected far initiation af the new system is the 2d Battalion, 62d Air Defense Artillery.

The Basic Hawk, a veteran af 10 years Army field service, has undergone substantial changes since its inception. Improved features include increased low-altitude effectiveness, utilizing continuous wave radar discriminatian against graund clutter; extreme guidance accuracy and missile simplicity, accomplished by semi-active homing guidance; and enhanced mability and versatility.

Additianally, the Improved Hawk battery has added all new missile and digital data processing af acquisition and fire-contral infarmatian. The missile has an added advantage in that it is certified ta be reliable far launch withaut need af field test ar repair. Major campanents are the missile and launchers, pulse acquisition radar, information caardinatian central, impraved continuaus wave acquisitian radar, battery cantral central, cantinuous wave illuminatar and range anly radar.

Safeguard ABM Defense System

Continuing assessment of threat potential based on information from many sources is critical to development of effectiveness

By LTC R. C. Westerfeldt

In any defensive system design, the primary building block required for the system to accomplish effectively its mission is knowledge of the threat against which it will be defending.

This knowledge can come in the form of a range of technical parameters (based on physical laws and known technological constraints) covering all threat capabilities that the system can defend within, or a detailed knowledge of the opposing threatening weapons systems and associated tactics.

The latter approach is the most cost-effective—if the threat can be identified and detailed for the operational life of the defensive system, and if the deployed system is able to change in response to unforeseen threat variations.

The Safeguard Ballistic Missile Defense System uses this latter technique, and relies upon the unique capabilities of the U.S. intelligence community to provide high-quality, high-confidence data to the system—in order to set the requirements to provide the highest system effectiveness.

The responsibility for assuring that the latest information is available for use when needed rests with U.S. Army Safeguard System Command, Huntsville, Ala. USASAFSCOM is continually acquiring intelligence data, doing independent technical analysis, and coordinating the requirements of the U.S. Government and contractor agencies that use the information in the design of BMD systems.

Imagine, for the moment, just a single reentry vehicle approaching over the horizon, targeted for an area defended by the Safeguard BMDS. The long-range Perimeter Acquisition Radar (PAR) (Fig. 1) acquires the target. It sees not only the reentry vehicle, but a myriad of other objects—the spent upper-stage tank, spent separation rockets or springs, shroud pieces, and numerous pieces of other types of junk.

Fig. 3. EARLY SYSTEM test intercept at Kwajalein Missile Range. The long thin streak is the reentering RV and the short crossing line is the intercept spotting charge. The brightest streak is the spent second-stage of interceptor missile burning up on reentry.

Fig. 2. SPARTAN Launch

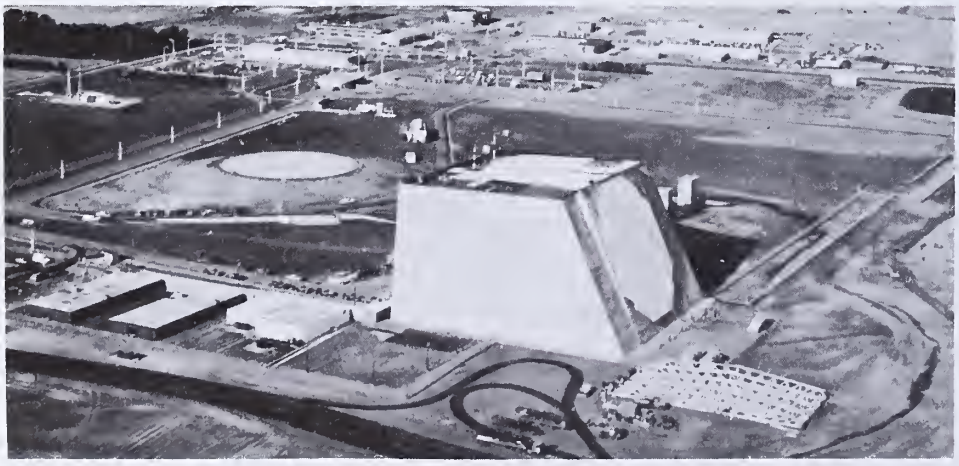


Fig. 1. Perimeter Acquisition Radar under construction at Grand Forks, N.D.

Now multiply this "cloud" by the number of reentry vehicles in a probable attack, and the problem faced by the system becomes evident. The time from the return of the first radar signal to the time required to identify the reentry vehicle for the Spartan interceptor missile is less than five minutes.

The radar beams must locate the multitude of oddly shaped objects, hitting each with a number of radar pulses. Then it must sift through the returned signals to sort out the elusive reentry vehicle, with the requirement for a high-confidence of the right choice.

Once this choice is made, a Spartan interceptor is launched (Fig. 2) and guided to the intercept point in space—with sufficient accuracy to place the defensive warhead close enough to the threatening reentry vehicle to destroy the protected warhead.

This closeness is the required limit on the "miss distance" that the system must provide, and is a design point. An early intercept of an reentry vehicle can be seen in Fig. 3, with the spotting charge of the interceptor showing as a slash across the reentry vehicle's trail.

If, for some reason, the threatening vehicle is determined not to be neutral-

ized, there is still a chance to get it within the atmosphere—after the majority of the accompanying tank, missile fragments and other "junk" are stripped away by the frictional reentry heat created by the atmosphere.

The brightest slash on Fig. 3 is the burning tank, where pieces can be seen breaking off. For this endoatmospheric task, a Sprint interceptor (Fig. 4), guided by the Missile Site Radar (MSR), is dispatched to destroy the invader. Here, too, we have only a limited time—less than a minute—to identify the vehicle.

For both the exoatmospheric and endoatmospheric portions of the engagement, the defense must have exact knowledge of the offensive threat objects; also, of the various phenomena associated with them, to allow the system to distinguish and intercept the reentry vehicle.

The system's software (trackers, computers, etc.) provides all this knowledge as defined by the designers and engineers. The first step in the process of defining the threat that a system will operate against was taken in 1969, during the early stages of developing a BMDS. During development of the Safeguard Sentinel System, U.S. intelligence noted that the Soviets were continuing construction of SS-9, SS-11 and SS-13 ICBMs (intercontinental ballistic missiles), and that they had started testing new triple-headed reentry systems (Fig. 5).

This information caused U.S. concern that a 3-warhead MIRV on the SS-9 (Fig. 6), together with improved accuracy and proliferation of SS-9 missiles, would give the Soviets a future capability of threatening the survivability of the Minuteman and Titan II defensive missile forces.

The administration redirected the Sentinel System program to a mission of protection of our land-based deterrent forces. Additional options were maintained at that time also to protect SAC (Strategic Air Command) bombers from a Soviet SLBM (Submarine-launched ballistic missile) threat (Fig. 1), and to protect the population from Chinese ICBMs, if those threats became a reality. Hence, based on an emerging threat, the system was redirected and renamed the Safeguard BMDS.

Fig. 4. SPRINT Launch from Underground.

Fig. 5. Soviet Test of 3-Reentry-Vehicle Payload for SS-9 ICBM.

Combining this general guidance with intelligence data, the Director of Defense Research and Engineering provided the Safeguard System manager with more explicit information on types of systems. Some broad guidance was given on technical details of the systems, and numbers to consider as the threat, taking into account other possible missions of the threatening offensive missiles in time of conflict.

This information was integrated into the major guidance documentation, the Safeguard System Master Plan. The SSMP is the primary management and design tool of the system, consisting of more than 100 documents.

The basic threat volume, SSMP Part 2.08, *Safeguard Design Threat,* is a key policy document within the over-all SSMP. It gives only that level of detail on the various threat systems that the various ballistic missile defense (BMD) associated agencies require for guidance. Extreme detail has been avoided, due to the nature of the management document.

As the implementing agency, USASAFSCOM has a requirement to acquire and provide various Government agencies and contractors. Safeguard Technical Specification 2.08, highly detailed threat information so that required performance, equipment and software requirements can be designed into the system to meet the stated threat.

It takes a great deal of experience, skill and foresight to assure that the threat a system was being designed to meet when it was conceived is the threat that will be in existence when the system begins operation.

Comforting to those charged with this critical responsibility is the fact that systems usually evolve in a reasonably predictable manner. The original threat can be updated as new intelligence data is acquired to make it more realistic. A perusal of the original threat documentation indicates the Safeguard BMDS analysts were very accurate in the projections.

Intelligence data comes from various intelligence agencies. Table 1 lists the agencies and types of information provided. The efforts cross service boundaries continuously, and the crossings normally are made without the slightest bump.

The proximity to HQ Safeguard System Command of the U.S. Army Missile Command (MICOM) Missile Intelligence Agency (MIA) contributes greatly to the smoothness of this operation. Dedicated personnel in the Foreign Intelligence Office of MIA provide coordination as required. A liaison officer from the Foreign Technology Division of the Air Force (FTD) also contributed importantly to this effort.

Personal visits to the various contributing agencies are made on a routine basis, for obtaining information and for

(Continued on page 6)

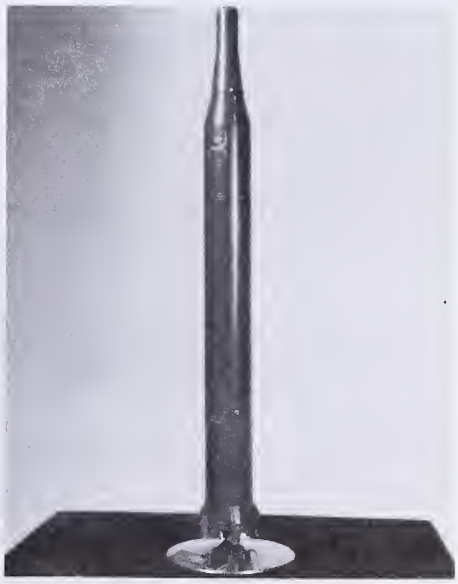


Fig. 6. Soviet SS-9 ICBM

Safeguard ABM Defense System

(Continued from page 5)

a free exchange of data and views (Safeguard personnel often can contribute to the intelligence community). Communicating detailed technical data that is classified, and explaining it in sufficient detail to make it lucid, is one of the problems.

To initiate intelligence data requirements, USASAFSCOM first forwards official taskings to the Defense Intelligence Agency (DIA) through the Assistant Chief of Staff for Intelligence (ACSI), in the form of Intelligence Production Requirements. IPRs are disseminated by DIA to the appropriate agencies in the form of production taskings, with priorities. Safeguard, a Strategic Defensive System, carries high priority.

To assist the various intelligence analysts in processing usable data, USASAFSCOM and its contractor, Bell Telephone Laboratories (BTL), have personnel visit and brief the intelligence analysts on the data required, and the use to which it is put in the Safeguard BMDS. These briefings have also provided a forum for the essential feedback between the user and producer of the information.

Requirements may arise to investigate parametrically many "what if" questions, such as: "What if the warhead in the vehicle is much harder to kill than intelligence says it is?"

Providing a quantitative answer to such a question is a complicated task. The revised warhead must still fit within the shell of the reentry vehicle and conform to the known physical aspects obtained from intelligence sources, such as the weight and the nuclear technology that is postualated from the country considered. This is, in effect, a system study with constraints, and is beyond usual services provided by intelligence.

Specific system details may be required that are beyond the normal range of information produced by intelligence. Again a system study is in order.

Sometimes a question is posed of possible advances in technology that are not believed credible by the intelligence community, but which the BMD community feels should be investigated as a "what if" to determine system sensitivity.

Questions like these are answered by Safeguard contractors and U.S. Government agencies on contract or taskings. For instance, USASAFSCOM uses a well-known contractor in the nuclear engineering field to develop threat reentry vehicle estimates. This information goes not only to Safeguard; it is provided also to the intelligence community for comment.

As previously pointed out, one of the tasks of the threat analyst is to foresee the future. He is assisted in this task by a document provided by the DIA called the Defense Intelligence Projections for Planning, or the DIPP. The appropriate projections are extracted from this and are woven into the Safeguard threat documents.

Again, judgment must be made of which information to extract, since the DIPP is a very general document, with numerous alternative projections, and the Safeguard BMDS has definite threat elements and scenarios to defend within.

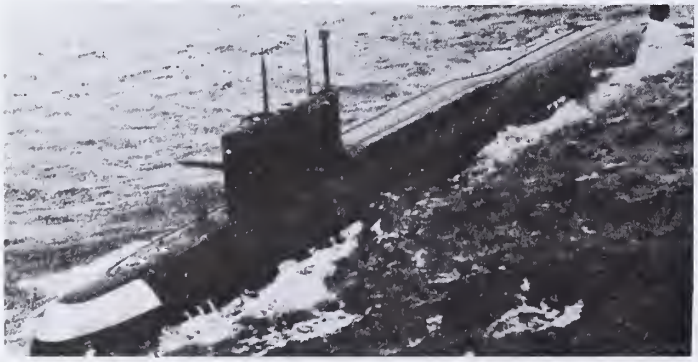


Fig. 7. SIXTEEN ballistic missiles are carried under the raised deck aft of the conning tower of this Soviet "Y" class submarine.

TABLE 1
Intelligence Agencies Contacted by USASAFSCOM

Assisting Agency	*Major Command*	*Area of Assistance*
Defense Intelligence Agency (DIA)	DoD	Coordination tasking for information
Assistant Chief of Staff, Intelligence (ACSI)	Army	Coordination tasking
Missile Intelligence Agency (MIA)	AMC	Coordination current intelligence ABM
Foreign Technology Division (FTD)	Air Force	ICBM RV
Naval Intelligence Support Center (NISC)	Navy	SLBM
Central Intelligence Agency (CIA)	National Security Council	Signature data
Defense Nuclear Agency (DNA)	DoD	Associated nuclear tests and studies
Atomic Energy Commission (AEC)		Vulnerability studies

A portion of the resultant compilation of data is then translated into the USASAFSCOM Technical Specification 2.08. This presents sufficient detail on the threat and associated information to make it useful to the Safeguard prime contractor in designing and implementing the system.

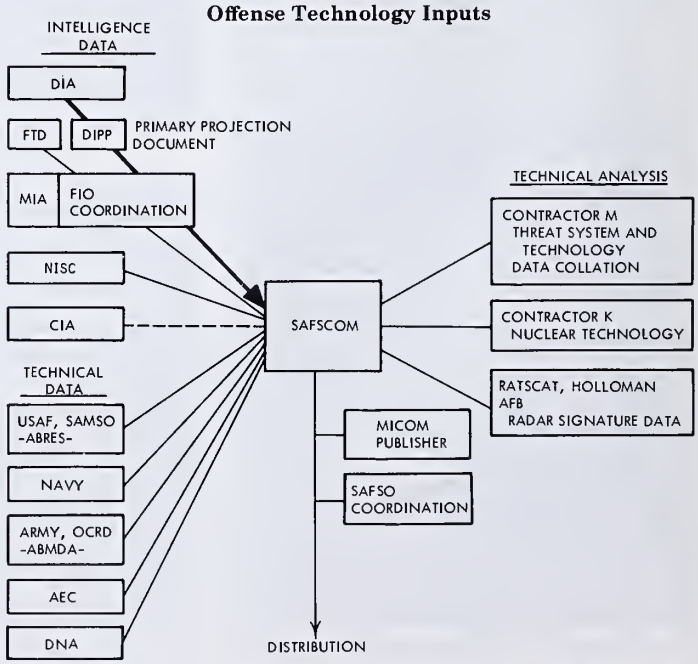
Some measure of the detail of the documents can be gained from the fact that the SSMP 2.08 Design Threat document requires one page to list technical details of a specific offensive weapons system; the Technical Specification 2.08 requires four pages to cover the same system in sufficient detail for use in system design. These supplemental details do not change the basic data of SSMP 2.08.

In the meantime, a wealth of information has been accumulated in determining the answers to "what if" questions, sensitivities and details previously mentioned. Only information directly pertinent to the system design is included in the technical specification.

This policy gave birth to another document, titled *Offense Technology for Safeguard System Studies* (OTSSS), more often referred to as simply "Offense Technology." This uses inputs from all the previously mentioned sources. The relationship of these inputs is shown in Table 2.

The OTSSS supports the data used in both SSMP 2.08 and the Technical Specification 2.08. However, it ranges much further and presents data in several different formats.

TABLE 2
Offense Technology Inputs



Extensive cross references enable an OTSSS user to locate desired information quickly and conveniently, though the document has now grown to three volumes of 500 pages.

The coverage of specific threat fields of technical interest includes intelligence-based analyses and backbround information on how, why and from what information the estimates and analyses were made.

Although the OTSSS is not considered an official intelligence document, its basis is the DIPP and other intelligence inputs; it agrees with current intelligence estimates, and it is an accurate assessment of current intelligence findings specially tailored to the BMD community's needs.

This document receives wide distribution within the BMD community, and to other U.S. Government agencies, contractors, and intelligence elements that have an interest in threat systems covered. It is updated and published yearly.

As a positive feedback to the intelligence community from the users, USASAFSCOM periodically evaluates intelligence documents for the originators. Assistance also has been provided in preparing requirements for various intelligence activities that have primary roles in collecting BMD-related data.

Intelligence analysts are invited to discussions with personnel involved in implementing intelligence into the Safeguard System, and to present papers or participate in symposiums held by USASAFSCOM concerning system effectiveness.

An interesting relationship has developed between USASAFSCOM and the Missile Intelligence Agency due to the proximity of the organizations and the ease of personal contact. A prime mission of the MIA is the analysis of foreign defensive missile systems, including antiballistic missile systems.

USASAFSCOM engineers have meetings and impromptu symposiums concerning specific areas of technical interest to the MIA analysts. MIA, in return, has kept appropriate USASAFSCOM personnel informed on the current status of foreign ballistic missile defense systems and technology.

MIA also provides specialized, periodic intelligence briefings which USASAFSCOM personnel may attend on systems of particular interest to the commander of USA-SAFSCOM for him to maintain the most current picture of the continually changing threat.

Although the Strategic Arms Limitation (SAL) Agreements have curtailed the 12-site Safeguard deployment and limited it to two sites, the importance of the capability to maintain current intelligence data has not decreased. Threat data are still required to support the Grand Forks, N.D., deployment and any future deployment, if authorized, in defense of the National Command Authority at Washington, D.C.

The level of this support will not decrease, but will probably increase to support a more diverse program, with the Safeguard BMDS continuing to play an important role in assuring proper utilization of the most current information.

LTC ROBERT C. WESTERFELDT is R&D coordinator, Systems Requirements Division, R&D Directorate, U.S. Army Safeguard Systems Command.

Graduated from the U.S. Military Academy (USMA) in 1957, he has attended the University of Alabama and Columbia University for graduate studies. His military schooling includes the Airborne and Ranger Courses at Fort Benning, Ga., and the Army Supply Officer Course at Fort Lee, Va.

He served at the USMA as an instructor in the Department of Ordnance (1961-64), as chief of the Missile and Rocket Section, HQ, U.S. Army Europe (1965-68), and as a staff officer, Assistant Chief of Staff, Military Assistance Command, Vietnam (MACV) in 1968. Prior to his assignment with the Safeguard Ballistic Missile Defense System, he was deputy director of the Combined Materiel Exploitation Center, HQ MACV.

LTC Westerfeldt is responsible for engineering and scientific research in the area of national effectiveness for the Safeguard System. Additionally, he has participated in the Source Selection Evaluation Board for Site Defense Prototype Demonstration Program and design review of the Safeguard System.

Army Studies Human Effluents for Health Diagnosis

Human effluents research results at the U.S. Army Biomedical Laboratory, Edgewood (Md.) Arsenal, have recently raised the hope that someday a doctor may obtain an instant diagnosis of a patient's health by putting him in a chamber and pushing a button.

Dr. Robert I. Ellin, chief of the clinical laboratory section, commented on the progress in this research: "I think this is one of the most exciting efforts we've ever been involved with here. There is a tremendous potential in this work that just needs to be developed. . . ."

Dr. Ellin headed the team that did pioneer work with human effluents—an area in which little previous research had been done. Effluents include all the chemical agents or components released by the human body.

Several years ago, the U.S. Army Land Warfare Laboratory at Aberdeen (Md.) Proving Ground developed the "people sniffer." It detects the presence of any unusual chemical agents that may be present in the air as a result of personnel or their activities in the area of the sample.

Used in Vietnam to detect the presence of the enemy in an area with dense foliage, the sniffer was effective but a problem remained. For unexplained reasons, it would work at times but on occasion would register the presence of personnel where there were none.

The Army was puzzled. Exactly what was it that was registering in the sniffer? Was it animal, vegetable, or mineral? What does the human body give off that may be detected by a mechanical device?

Dr. Ellin and his team set themselves to answer these and other questions. The team included Dr. Richard L. Farrand, Norman B. Billups, William S. Koon, Nelson P. Musselman, Charles L. Crouse, Dr. Frederick R. Sidell, Jack Harvey and Dr. Fred W. Oberst.

"This was something almost entirely new," Dr. Ellin explained. "Before this, almost all work with effluents was being done on a very limited scale. There had been work done to identify the components of the breath and urine, but these are only a small part of the whole. We work with the entire body.

"The practical uses that could be found for this data with more research in this area are endless. But there are still many questions to be answered and a lot of work to be done."

To date, 135 chemical components emanating from the human body have been identified and measured, but Dr. Ellin suspects that there may be three or four times that many remaining to be identified.

When the research team began its work in 1968, it had little on which to build the program. The most accurate and sensitive of several sampling and analyzing methods had to be selected before work could begin.

To obtain reliable samples of human effluents, a special chamber had to be constructed; slightly smaller than a telephone booth, it is made entirely of stainless steel.

No rubber, plastic or other substance that might emit its own components could be used inside the chamber.

(Continued on page 11)

HUMAN EFFLUENTS sampling is carried out in a specially constructed chamber at the U.S. Army Biomedical Laboratory. Charles L. Crouse, laboratory team member, secures door of the chamber.

Synthetic Flight Training System Gives Students Feeling of Aircraft

Considerable realism has been added to simulated flight training by the new synthetic flight training system (SFTS), a ground-based method being introduced into Army aviation.

Experienced Army pilots who have "flown" the SFTS say it duplicates sensations felt in real aircraft in flight. The UH-1H, backbone of the Army's aviation fleet, is among the aircraft whose flight characteristics are being simulated.

Long-range plans for over-all simulator development call for a 3-phase program, the first being the UH-1H unit subsystem now in operation at Fort Rucker, Ala.

The second phase, recently initiated, involves development of a CH-47 operational flight trainer (OFT) subsystem consisting of one cockpit with a visual device.

In the third phase, an AH-1G Cobra TOW (tube-launched, optically-tracked, wire-guided) OFT subsystem with visual device is programed for development during FY 74.

The SFTS UH-1H subsystem consists of four cockpit modules, four motion platforms, a computer module and an instructor station. Powered by hydraulic actuators, the motion platform is driven with the simulated fidelity of an aircraft.

Each of the cockpit modules can be programed to perform independently a number of aircraft maneuvers. Among these are ground control approach, nondirectional beacon approach, and instrument landing system approach.

One instructor can train four pilots simultaneously on the SFTS. Each cockpit has its own closed-circuit television which permits the instructor to record trainee performance.

Noise is provided by a generator whose aural clues to the trainee simulate all sounds normally associated with operation of the aircraft. A 5-degree-of-freedom motion system provides acceleration cues in vertical, lateral, pitch, roll and yaw axes.

Seven more UH-1H field unit subsystems (SFTS) are programed for the Army Aviation School. Eventually, an additional eight UH-1H and CH-47 subsystems are scheduled for worldwide use.

Through the use of its digital computers, memory cores, instructor pilot display consoles and the latest advancements in flight simulation devices, the SFTS can expand the learning process in instrument and contact training.

The instructor pilot is provided with capabilities not available in a training aircraft, such as freeze action and instant playback. The student's knowledge of the aircraft is greatly improved since the SFTS can simulate emerging conditions and corrective actions not safe to attempt in flight.

The first UH-1H prototype was delivered to Fort Rucker in December 1970. During the next year, the device underwent engineering and extended service testing. In June of this year, the UH-1H field unit subsystem was type-classified for Army-wide use after 3-phase operational stability testing.

Phase I was planned to determine the workability of various training features of the device. This included examination of automatic mode training exercises, automatic scoring, audio alerts, coaching messages and certain automatic scheduling and sequencing programs.

Findings in the first phase indicated that all these features were workable and useful for training. The objective of Phase II was to develop a training program that would utilize those device features for basic and advanced instrument maneuvers, UH-1H emergency procedures, and UH-1H transition.

During the last two weeks of Phase II, method-of-instruction training was scheduled for the nine flight instructors assigned to conduct Phase III training. Four of them had been assigned since the operational suitability test began. Being thoroughly familiar with the equipment, they assisted the research staff in program development.

Synthetic Flight Training System (SFTS)

Major activities during Phase II of the test consisted of device familiarization for newly assigned personnel and standardizing the work of all instructors in administration of the new training program. With its capability for monitoring activities in four cockpits simultaneously, the SFTS proved to be an excellent device for instructor standardization training.

The final phase of the suitability test involved a transfer of training study and determination of training costs.

During this phase, the training program developed in Phase II was administered to 16 officer trainees selected from among 34 who had completed Army primary training in rotary-wing aviation. They had no prior instrument training and relatively little flight experience before entering the Army program.

All instrument training was conducted in the SFTS on a proficiency basis. Instrument flight-related academic instruction was supervised by each trainee's instructor pilot (IP) using programed textbooks.

When the IP determined that students met all proficiency required for an Army standard instrument rating, they were scheduled for instrument check rides in the SFTS.

Table 1 shows the amount of SFTS training each student received. Finally, each student was given an instrument checkride in the SFTS by a qualified Army instrument examiner who had not participated in the study.

The time required for conduct of the checkride and the grade received are shown in Table 1. Students 5 and 13 did not pass the checkride the first time it was administered but were successful after receiving additional training.

Table 1 includes all training and checkride time required by these students. Army Aviation School policy is to assign the grade of 70 when any checkride is passed after having once been failed, regardless of the quality of the recheck performance.

The mean time for these students to pass the required instrument checkride in the SFTS was 42 hours 50 minutes. Of this, 40 hours 28 minutes were devoted to training and 2 hours 22 minutes to evaluating student performance during checkrides.

TABLE 1
Training and Checkride Time Requirements and Checkride Grades of Test Students in the SFTS

Student number	Training time	Checkride time	Total time	Checkride grade
1	33:15	2:15	35:30	89
2	35:00	2:00	37:00	82
3	35:00	2:00	37:00	84
4	37:30	2:00	39:30	73
5	39:00	4:15	43:15	70
6	40:00	2:15	42:15	85
7	40:30	2:15	42:45	90
8	40:45	2:00	42:45	91
9	41:00	2:15	43:15	90
10	42:00	2:00	44:00	94
11	42:15	2:45	45:00	89
12	43:00	2:00	45:00	92
13	43:45	3:30	47:15	70
14	44:00	2:15	46:15	80
15	45:00	2:00	47:00	82
16	43:35	2:00	47:35	86
Mean	40:28	2:22	42:50	84.2

TABLE 2
Aircraft Familiarization and Checkride Time Requirements and Checkride Grades of Test Students in the UH-1

Student number	Training time	Checkride time	Total time	Checkride grade
1	3:00	2:00	5:00	87
2	3:00	2:45	5:45	88
3	6:15	2:00	8:15	88
4	4:45	2:00	6:45	84
5	6:15	3:15	9:30	70
6	5:00	2:00	7:00	85
7	6:45	2:00	8:45	84
8	3:00	1:30	4:30	91
9	3:00	2:00	5:00	83
10	4:00	2:00	6:00	82
11	3:30	2:00	5:30	85
12	3:45	2:00	5:45	80
13	3:30	2:45	6:15	83
14	5:30	3:00	8:30	78
15	3:15	1:45	5:00	74
16	2:45	3:00	5:45	70
Mean	4:12	2:15	6:27	82.0

This compares to the total training and evaluation time scheduled for all conventionally trained students of 86 hours — 60 hours in the TH-13T aircraft plus 26 hours in the modified 1-CA-1 simulator device.

After passing the SFTS instrument checkride, experimental trainees were judged to be qualified for a standard instrument rating. Present Army regulations, however, require that such an award be made only upon the basis of performance during a checkride conducted in an aircraft.

Therefore, to conclude the test, each trainee transitioned from the SFTS to an instrument-equipped UH-1H, in which none had prior flying experience.

Table 2 shows the amount of time devoted to this aircraft familiarization activity. Transition training was restricted to simulated or actual instrument conditions. It was presumed that all necessary instrument training had been conducted in the SFTS. The aircraft time required ranged from 2 hours 45 minutes to 6 hours 45 minutes, due to the IP's judgment that some needed more familiarization than others. The mean time was 4 hours 12 minutes.

All 16 trainees satisfactorily passed the checkride on the first attempt except Number 5, who passed on a second test. The total time for conduct of the experimental training in the SFTS and familiarization flights in the aircraft was seven to eight weeks.

Results achieved in Phase III proved the efficacy of transferring training between the SFTS and the UH-1H aircraft. Results are not considered surprising in view of the experience of commercial airlines with their simulators. The notion that the SFTS-trained students "missed something" by not flying the TH-13T aircraft is not supported by any test findings.

The sole mission of the TH-13T at the Aviation School is to serve as a training vehicle for rotary-wing instrument flying skills. The SFTS can be used to impart the same flight skills in less time and cost.

Because there is considerable confidence value in actual flight, it is not envisioned that the SFTS will eliminate the need for some aircraft flight instruction. However, the test program indicates that, with properly designed equipment and training programs, much of the training now conducted in aircraft could be accomplished more efficiently and inexpensively on the ground.

Fort Detrick Getting Mobile Satellite Earth Station

Installation of an AN/MSC-60 earth station and its 60-foot parabolic dish antenna near Fort Detrick, Md., initiated with recent groundbreaking ceremonies, is expected to increase significantly military satellite communications capabilities.

Scheduled to be ready for operation in 1973, the Mobile Satellite Communications earth station will have an antenna reaching 82 feet above the ground when mounted on its concrete pedestal.

Completely air-transportable when disassembled, the station incorporates the latest advances in satellite communications design and engineering. The terminal will become an integrated part of the communications center of the U.S. Army Strategic Communications Command's (STRATCOM) East Coast Telecommunications Center.

Research and development was completed in 1972 on the satellite terminal, which will form a vital link in the Defense Satellite Communications System.

In November 1971 two new satellites were launched into stationary orbit 22,300 miles above the earth from Cape Kennedy, Fla. These have much higher power and provide coverage over a wider ground path than those used earlier.

Each satellite carries an earth-coverage antenna and two narrow-beam antennas. The former radiates power in a beam that covers the entire portion of the earth visible to the satellite—an area about 9,000 miles in diameter—while the narrow-beam antenna covers 1,000 miles in diameter.

The effective radiated power from the narrow-beam antenna will be 20 times greater than from the earth-coverage antenna. All three antennas may be used simultaneously and the narrow-beam antenna can be steered to point on any portion of the earth's surface visible to it.

The satellite earth station location will provide the East Coast Telecommunications Center with the capability of relaying messages to other satellite earth stations halfway around the world via a single satellite.

Automated Engineering Document System Concept Indicates Annual Savings of $174 Million by Department of Defense

Evaluation of a prototype pilot study of an Automated Engineering Document Preparation System (AEDPS), under evolutionary development since 1964, indicates savings estimated at $174 million annually could be achieved by its Department of Defense implementation.

AEDPS is the brain-child of Roland Guard, manager of the Engineering Data System, Standardization Area, U.S. Army Missile Command. Employed at HQ MICOM, Redstone (Ala.) Arsenal since 1955, he has been developing the AEDPS concept as an offspring of other projects on which he has worked since 1963.

Roland Guard

Guard describes the AEDPS as an engineering tool using computer technology to prepare procurement documents at a fraction of the current cost of manually writing specifications, purchase descriptions, and similar papers. A single specification may require from six weeks to six months by following current procedures, he states.

Potential importance of Defense-wide adoption of the system is indicated by a statement in 1964 by recently retired MG Allen T. Stanwix-Hay. Then the head of the Office of Technical Data and Standardization Policy, Department of Defense, he estimated DoD purchase documents cost at $2 billion a year.

If used Army-wide, Guard estimates, in an AEDPS final project report published in 1971, the system could print a typical purchase document in about one minute at a cost $27, compared to $500 for some documents at present. Further, he estimates that Defense-wide adoption could cut average cost to $12.

The U.S. Army Materiel Command will begin implementation of the AEDPS on a command-wide basis Jan. 1, 1973, and is striving to make the system fully operational by the end of one year. The immediate target is 9,000 AEDPS-prepared documents within this period.

Army-wide, roughly $33 million could be saved, Guard estimates, by using AEDPS to prepare about two-thirds of the Army's exception type documents—those slightly different from descriptions in existing specifications. Other savings would accrue from avoiding duplication, needless design configuration testing, and unnecessary item entries.

In addition to these tangible monetary savings, the system reduces proliferation of specifications, concentrates on technical aspects of procurement rather than on inconsequential matters of format and syntax, and provides visibility of available documentation.

AEDPS lets one contractor know what another one is using, thus allowing them to identify and develop additional sources of supply, thereby encouraging a growth of competitive procurements.

A further fringe benefit of AEDPS is the rigor with which the Specification Requirement Sheet (SRS) must be prepared. Serving as an optimum check list, it may reduce or even eliminate needless overspecification and subsequent revision.

A *generic name* is the basic and unmodified name of a materiel item. The pilot AEDPS contained 12 generic names: fixed resistors, variable resistors, fixed capacitors, washers, rotary switches, illuminated switches, transformers, relays, terminal boards, fuses, and fuseholders.

Special AEDPS military standards as catalogs for each of the 12 categories enable the user to describe exactly the item he needs in preparing an SRS. Information from a correctly prepared SRS programed directly into the computer results in preparation of a document closely resembling a normal specification.

Military specifications, consisting of six highly formalized sections, are usually written by the cut-and paste-method, an approach for which a computer is ideally suited. The AEDPS document has the standard six parts of a military specification, to which is added a brief summary so that the user can verify that he has included every necessary detail.

Several previous efforts to cut the cost of preparing procurement documents have led to pitfalls that were expensive in troubleshooting, lost time, and in substitution and retrofit.

Consequently, the AEDPS was tested by having it prepare 1,000 documents to reflect special design requirements of the Army, the Navy, and the Air Force. They were reviewed as they came from the computer and then forwarded to the Martin-Marietta Corp. (MMC) for a secondary review.

MMC was selected because its Baltimore branch does work for the Navy, its Denver branch does work for the Air Force, and its Orlando branch does work for all the Armed Forces. When errors were detected, the SRS and the AEDPS data bases were corrected until satisfactory documents were produced in every case.

Pilot AEDPS run findings included a need for a write-in capacity to request special parameters or tests; for a reference to a vendor's part number; for a program to train users in preparing the SRS; and for the capability of allowing multiple-dash numbers in a single automated document. AEDPS dash numbers are a means of specifying small differences such as the resistance of a resistor for various otherwise identical items described in a single document.

Further identification included a capability of searching existing documentation over a range as well as for discrete values, simplifing the SRS, and separating the materials and finishes from the basic catalog of military standards.

Improvements to the pilot model software consisted basically of modifying all of the data base programs; also, writing nine new ANSI COBOL programs to collect necessary systems management information about AEDPS as well as to produce statistical data concerning the operation of the system.

The Data Base Creation program was improved and made less subject to human error, the program execution system was made more flexible, and the execution time of the system was reduced.

Document requests can now be processed by AEDPS in any of three modes: Search, Write or Incorporate.

In the Search mode, AEDPS will check its own file of exceptions. The system returns to the requester all suitable AEDPS documents in the memory bank.

In the Write option, AEDPS will do everything that it does in the Search mode. In addition, if it fails to find a suitable document, it will write one for information purposes only. When the user provides the AEDPS with a vendor part number, the response transforms the original request into a purchase document and adds the document to its memory bank after printing a copy.

Provided a vendor part number has not been supplied within six weeks, AEDPS will purge itself of the data. When the number has been supplied but some other problem has arisen, such as a

need to redesign the product, the AEDPS will wait for a decision.

In the Incorporate mode, the AEDPS will operate as it does in the Search mode except that if it fails to find a suitable document it will prepare one for the user. The system will not operate in the Incorporate mode unless it has been furnished with a valid vendor part number and suggested sources of supply.

The SRS must be prepared with absolutely no mistakes, and new users regularly spoil their first 10 or 12 forms. Preparing an SRS is completely a linear process and therefore lends itself ideally to computer-aided instruction. Such a course has therefore been included in the AEDPS program and set up at the U.S. Army Logistics Management Center, Fort Lee, Va. In approximately four days a student learns how to prepare an error-free SRS, as compared to the normal 3-week specification writing course.

The new SRS, developed after the AEDPS pilot run, is designed to save time, money, and to simplify revision. Guard kept economy in mind throughout the pilot run study evaluation. He decided to retain the existing software, modified as little as possible.

Response time of the AEDPS, ranging from several minutes to a few hours, is acceptable now, although improvements will be necessary later. The hardware for the remote terminals, consisting of a teletypewriter hooked to a magnetic tape transceiver, was selected from off-the-shelf equipment because it is moderately priced and economical to modify and maintain.

Several existing supply data systems could eventually be interfaced with AEDPS, Guard says. The Engineering Data System (EDS-0009) consists of supply data encoded in binary form on 16mm film that a computer can read out in 13 seconds. The Federal Item Identification Guide is currently computerized; it contains a catalog description of all listed items but none of the test descriptions essential for specification writing.

The Defense Integrated Data System, which is basically for management reports, is not computerized now but is expected to be operational by 1980. At present, the Engineering Data Retrieval System consists of data optically recorded on microfilm for manual retrieval, but Guard believes it could be transferred to a computer data bank.

Depending on user demand and other factors, the AEDPS could operate using any of three systems: Totally Interactive, Partially Interactive, or Off-Line Batch.

Under the Totally Interactive System, the user would be in contact with the central computer at all times by means of a remote terminal. The user would be notified at once if errors were discovered in his data, and he could make any necessary corrections.

Once accepted, his data would be held on a disc file for about an hour, or until 40 requests had been received. The computer would then go into operation and the purchase document would be transmitted to the user's terminal in approximately one hour.

The Totally Interactive System would also enable the user to retrieve any document in the AEDPS data bank.

Under the Partially Interactive System, the user would be in contact with the central computer only while his request was being edited. His request would then be held on a disc file until the end of the day. All requests would be processed in batches, and the user would receive his document at his remote terminal in about 24 hours.

Under the Off-Line Batch System, the user communicates by mail or—if he has access to an automatic digital network—by AUTODIN. Requests are keypunched during the day and fed into the computer at the end of the day. The documents generated by the computer are returned to the user by AUTODIN or by mail in not more than five days.

The totally Interactive System would be very fast and would allow both instant on-line editing of input data and remote correction of the data. However, due to the cost of communication facilities as well as of equipment and supplies, it would be the most expensive of the three systems.

The Partially Interactive System would give the same editing and correcting capability as the Totally Interactive, but would lengthen the response time to as much as 24 hours. It would require less central computer memory, and the cost of communication and of communication control would be less.

The Off-Line Batch System is the most economical but the least flexible. There is a smaller central computer, lower programing cost, and no communication network expense. But the turnaround time is increased to an average of seven days, there is no on-line editing or correction of data, and the user has no possibility of on-line retrieval of existing documents maintained by the system.

AEDPS is planned for expansion at the rate of 22 generic names a year through FY 76 and 17 more during FY 78 to make a total of 139. The Off-Line Batch System appears adequate at present. However, when such systems as Electronic Circuit Analysis by Computer (ECAP) and Computer Aided Design (CAD) are perfected, a requirement for the quick response of the Totally Interactive System is anticipated.

AUTODIN may evolve to the point that it can provide the AEDPS with the necessary degree of interaction. With its low-speed electromechanical equipment and its need for manual intervention, AUTODIN is suited at present only for the Off-Line Batch System.

Meanwhile, it is planned to give the school at Fort Lee a Totally Interactive System link for instructional purposes. As modern technology accelerates, the AEDPS is expected to develop into both military and civilian applications.

Human Effluents Research Conducted at Edgewood

(Continued from page 7)

Before effluent samples are taken, the chamber is thoroughly cleaned on the inside and, for several hours prior to a session, clean air is circulated through it to remove any lingering "background" components.

The human subject must also be prepared. For two days before he enters the booth, he must bathe without soap and he must not shave or use toothpaste. This is necessary to make the effluent samples as free from outside chemical components as possible.

After the subject is inside the chamber, clean air is circulated through it. As air samples are collected for analysis, the samples are fed into a gas chromatograph. This instrument separates and measures the various components, which are then directed into a mass spectrometer for precise identification.

Only the research groundwork has been laid. It still isn't known how a person's diet affects the effluents, whether races can be identified by these effluents, or if each person has a completely unique effluent pattern.

The answers to these and other questions must wait for further research, but when they are found, Dr. Ellin believes they could have a far-reaching effect on future medical and biological science.

Relative to a total analysis of a patient's health by diagnosis of effluents, he said:

"This can be done if we can learn the correlation between certain disease states and the amount, type, or rate of discharge of various components. This goes for mental disease as well as physical disease. A computer can be hooked up to provide a tentative diagnosis of whatever disease the patient may have—without physically touching him."

HumRRO Studies Parole, Delinquency

Work Unit RETURN of Division No. 2 of the Human Resources Research Organization (HumRRO) at Fort Knox, Ky., is to publish for open release *A Partially Annotated Bibliography on Prediction of Parole Success and Delinquency.*

The goal of Work Unit RETURN, which is sponsored by the Army's Provost Marshal General, is the development and evaluation of a system of pre-lease indicators for predicting the probability of a military prisoner's satisfactory readjustment to his environment.

Authors of the study are Robert L. Dyer and James H. Harris.

Technology Assessment

Army Responds to National Call for Improved R&D Planning

Technology Assessment, growing out of the unexpected adverse environmental and ecological impact of some technological advances, has been added to Army responsibilities as well as to those of the nation with recent legislation establishing a separate TA office.

Public Law 92-484, The Technology Assessment Act of 1972, signed by President Nixon on Oct. 13, provides for the new Office of Technology Assessment as an arm of Congress with an annual budget of $5 million. The OTA will operate much like the powerful General Accounting Office (GAO).

The law also sets up a Technology Assessment Board composed of six senators and six representatives, a Public Advisory Council, and a director who will be the operating official. A small staff is envisaged at the outset, with major work done under contract.

In anticipating its future role in Technology Assessment (TA), the Army recently held an important conference at the National War College, Washington, D.C., to introduce TA concepts in policy formulation and decision making.

About 120 top-level Department of the Army (DA) managers, particularly directors and associates, participated.

Conference speakers focused on the relevancy of technology assessment today. They referred to public demands for more thorough analysis of the societal impact of technology, and to the Army's need to consider TA within the framework of military technology.

Prof. Melvin Kranzberg, Georgia Institute of Technology, told conferees that TA is important to the Army for three reasons: "Military R&D is very big dollarwise; military technology often results in non-military applications; and military R&D and procurement spending often impacts on the civilian sector."

All speakers emphasized the role of TA as an input to public policy decision making and policy formulation. They also referred to it as a means of upgrading the sophistication with which the Congress and the Army can deal with issues of high technological content.

TA itself and the OTA will have an impact on the Army in several ways. The existence of OTA will lead to requests for assessment studies on military technology, not necessarily to be performed within the Department of Defense.

The general trend toward a more careful analysis of the effects of technology also will lead to an expectation that the Army (and other agencies, industry and universities) will voluntarily consider the human and social parameters in R&D planning and management with full knowledge that Congress is an observer.

Director of Army Research BG Charles D. Daniel Jr. requested attention to three areas he said must be considered for Army involvement in TA:

- Assessments of military technology in military applications (the laser, weather modification, etc.). This may take the form of Army-initiated efforts or externally initiated efforts to which the Army must respond positively.
- Assessments of military technology in nonmilitary applications such as nonlethal weapons, behavior control drugs, etc. (This, he said, is especially important in view of the increasing pressure for technology transfer. He stressed that the Army must avoid the possibility of transferring technology to the civilian sector which could have undesirable impacts without at least providing a warning to that effect in TA form.
- Assessments of the impact of nonmilitary technology on the Army. (Computer-assisted instruction, he explained, could lead to a more intelligent recruit, permitting more complex weapons systems. In turn, this could force more changes in personnel management.

BG Daniel said that for these reasons, "It behooves the Army to develop a cadre of several individuals who are 'plugged in' to the overall TA effort in order to monitor these activities and identify issues and efforts of concern to the Army."

In a recent memorandum to the Army Chief of Research and Development, summarizing conference highlights, BG Daniel proposed the formation of a group of project managers to organize and direct activities of multidisciplinary teams to perform Army TA.

Specific TA Centers are not necessary, he said, but the Army must proceed in a deliberate manner to develop a small group of five or six knowledgeable individuals in the Washington area and a small group of contacts in the laboratories to be called upon as needed.

Plans are under way to establish a TA Working Group, made up of selected individuals from the Army R&D community and knowledgeable outsiders.

Among the latter are Dr. Walter Hahn, Library of Congress; Joseph Coates, National Science Foundation; and Dr. Joel D. Goldhar, Rensselaer Polytechnic Institute.

This group will meet as appropriate to discuss TA methodology and techniques for organizing and managing multidisciplinary efforts. Utilizing the conclusions of this working group, an Army in-house group will undertake a pilot TA on lasers. This is expected to become a learning experience for the group and an important R&D planning document.

The Office of Technology Assessment is expected to depend mainly on contracts with outside groups. These may include universities, private research organizations termed "think tanks," the U.S. Government General Accounting Office, the Library of Congress, and the National Science Foundation (NSF). The NSF already has several pilot TA projects under way.

Although scientists and others are still debating whether what may happen to the nation's environment and ecology can be successfully assessed, Presidential Science Adviser Edward E. David Jr. has said: "We must develop the techniques necessary."

In this regard, BG Daniel assured the conference participants that the Army is taking positive steps to fulfill its TA responsibilities, now and in the future.

Moire Patterns Used for Contour, Vibration Studies

Potentials of using moire patterns to obtain contour sums and differences, and for vibration analysis, are explained in a report by Dr. J. Der Hovanesian, Oakland University.

Moire patterns are produced with the aid of a viewing camera and projector when figures with periodic rulings are made to overlap. The only general requirement for a moire pattern is that the interacting figures have some sort of solid and open regions. The solid regions can be lines (straight, curved, or wiggly), dots, or any other geometric form. The resulting pattern has an appearance similar to that obtained with optical interference.

Using two offset projectors, measurements of the contour sums or differences may be made, thereby determining contours of various objects or comparing the contour of a standard with that of a replicate. Real-time analysis may also be performed.

Moreover, moire sensitivity is variable. Unlike holography, which is limited to measurements in the microwave range, moire sensitivity may be varied and can be used for large dimensional readings as well as small ones. Grids in the inch range or more can be used.

To illustrate the range of the method, Dr. Der Hovanesian plans to make a contour analysis of a Boeing 747 and would like to make one of a ship's hull. He has made a contour analysis of a head and checked a tire and ball bearings for anomalies. He also has used moire fringes for vibration analysis.

In summary, Dr. Der Hovanesian states: "Several new incoherent techniques, which extend moire analysis to studies of certain differences, contour sums, image enhancement of dull objects and modal analysis of vibrating objects, have been introduced. This method overcomes many of the limitations of holography: 1) Sensitivity can be continuously varied, 2) Interferometric stability is not required, and 3) Real-time analysis may be performed without stroboscopic techniques."

Professor Box Receives Wilkes Award At Design of Experiments Conference

More than 50 organizations were represented by about 170 participants in the 18th Conference on the Design of Experiments in Army Research, Development and Testing, highlighted by presentation of the Samuel S. Wilkes Memorial Award to Prof. George E. P. Box.

The University of Wisconsin professor and holder of the Ronald A. Fisher Chair of Statistics was selected for the most prestigious annual award of the American Statistical Association on the basis of his significant contributions to the advancement of knowledge in Army statistics. The award was initiated by the Army in 1964, in a joint effort with the ASA.

One of the stipulations governing the award is that the statistical contribution of the recipient must foster cooperative scientific matters which benefit the Army, Department of Defense, the U.S. Government and the nation.

Sponsored by the U.S. Army Mathematics Steering Committee on behalf of the Chief of Research and Development, Department of the Army, the conference was held at Aberdeen Proving Ground, Md.

The host agency was the U.S. Army Test and Evaluation Command. Presiding chairman was Dr. Frank E. Grubbs, chief operations research analyst at the APG Ballistics Research Laboratories and the initial Wilkes Award recipient. Gerald T. Dobrindt of TECOM was general chairman of arrangements.

Among technical papers featured during the conference were five presentations by outstanding guest speakers. Prof. John Tukey, the 1965 Wilkes Award winner who has gained world renown as a professor at Princeton University, spoke on "Exploratory Data Analysis." Prof. J. Stuart Hunter, also of Princeton University, discussed "Sequential Factorial Estimation."

Prof. Box was a guest speaker on "Forecasting and Control." Prof. G. S. Watson, Department of Statistics, Johns Hopkins University, presented "Orientation Analysis" and Prof. Raymond H. Myers, Virginia Polytechnic Institute and State University, gave his views on "Dual Response Surface Analysis."

Thirty-six additional presentations during 15 technical sessions of the 3-day conference included "An Improved Method of Estimating the Critical Velocity of a Projectile in Penetration Ballistics," by G. J. McLaughlin, Defence Research Establishment Valcartier, Courcelette, Quebec Province, Canada.

SAMUEL S. WILKES AWARD RECIPIENT Prof. George E. P. Box (right) is congratulated by Frank E. Grubbs, chairman of the American Statistical Association committee that selected him, following presentation ceremonies at the 18th Conference on the Design of Experiments in Army Research, Development and Testing. Prof. Box was cited for ". . . evolutionary operations, Bayesian methods and time series analysis, and for his leadership in relating theoretical results to practical problems." The award, honoring a world-renowned Princeton University statistician, includes a medal and a cash honorarium from a fund donated by Philip G. Rust, a retired industrialist residing in Thomasville, Ga. Prof. Box has been recognized as one of the world's leading statisticians since he was awarded the British Empire Medal in 1946 for outstanding services during World War II. He is a Fellow of the Royal Statistical Society, the American Statistical Association, a member of the International Statistical Institute and of the Biometrics Society, and senior member, American Society for Quality Control.

Papers representative of U.S. Government agencies other than the Army included "Techniques for Tail Length Analysis," James J. Gilliben, National Bureau of Standards (NBS); "Grubb's Estimators to Date," Clifford J. Maloney, U.S. Food and Drug Administration; and "A System for Position-Location Based on Ranges," Richard H. F. Jackson, James A. Lechner and David J. Sookne, NBS.

Panel members for an open discussion on the design of experiments in Army research, development and testing included: Prof. Herbert Soloman, George Washington University; Dr. Bernard Harris, Mathematics Research Center, University of Wisconsin; Prof. Boyd Harshbarger, Virginia Polytechnic Institute; and Prof. A. Clifford Cohen, Institute of Statistics, University of Georgia.

Dr. Grubbs also headed the American Statistical Association committee which selected Prof. Box for the Wilkes Memorial Award. Members included Prof. Robert E. Bechhofer, Cornell University; Dr. Fred Frishman, Army Research Office, Office of the Chief of Research and Development, HQ Department of the Army; Prof. J. Stuart Hunter, Princeton University; and

Prof. Oscar Kempthorne, Iowa State University; Dr. Badrig Lurkjian, U.S. Army Materiel Command; Prof. Fred Leone, University of Iowa; Dr. William R. Pabst Jr., Washington, D.C.; and MG Leslie E. Simon, U.S. Army, retired.

Intern Programs Stressed to Meet Anticipated Retirement of Employes

Projecting manpower needs in 5-year periods, the Army's civilian career management program is placing considerable emphasis on the entry level intake of its work force.

The Army is focusing on career management to offset the losses anticipated in the next few years from retirement of large numbers of employes hired during World War II. It is recognized that a planned intake of highly qualified individuals is essential to the development and maintenance of an efficient and effective career work force.

While individuals from outside the Army are given consideration for all levels of career program positions, primary emphasis is placed on recruiting career interns at the junior level. Most of them are recent college graduates, or high-potential employes in the work force.

All career interns are trained in programs designed for their respective career fields. The intent of each program is to develop qualifications by a series of progressively responsible assignments coupled with appropriate formal training for eventual assignment to positions at the journeyman level.

At this point, the formal intern training program comes to an end. However, the career system continues to provide career counseling, developmental opportunities and broad areas of consideration for promotion. Some interns will eventually be selected for top Army positions in their career fields.

Recruiting methods for the various career programs vary in the different major commands. The Army Materiel Command (AMC), for example, has a highly centralized program. Operating out of four offices under the direction of HQ AMC, technical placement officers do all intern recruitment. In this way, AMC is able to monitor more closely intern mobility, education, minority and female recruitment, and other areas of special concern.

The Corps of Engineers has a decentralized program with Engineer Districts doing their own recruitment. This allows quality matching of interns and jobs at the local level.

In the Continental Army Command (CONARC), the CONUS (Continental U.S.) Armies administer their own intern programs.

These three methods reflect the different needs of the organizations that recruit about 80 percent of the Army's career interns.

HumRRO Study to Identify Mine Detection Skills

Identification of the traits and abilities that best enable a soldier to detect mines and boobytraps, and how to develop and enhance those traits, is the subject of Project IDENTIFY, to be undertaken by Division No. 4 of HumRRO (Human Resources Research Organization) at Fort Benning, Ga.

The project, scheduled to last for 8 months at a cost of $32,000, will be under the supervision of Theodore Powers. Division No. 4 is equipped for testing human effectiveness in using special acoustical and electronic equipment, but IDENTIFY will be particularly interested in the visual skills of effective mine locators.

R&D News . . .

Barge-Mounted Laser Tested by Engineers for Water Hyacinths Control

Laser power, one of the miraculous and most amazingly versatile tools of modern science, is being used experimentally by the U.S. Army Corps of Engineers to destroy a beauty that has turned into a "beast" scourging many important U.S. waterways.

That statement is not new—in fact, it is somewhat of a restatement of the theme of a page 1 article in the *Army Research and Development Newsmagazine,* April 1969 edition.

What is new is the experimental progress—the use of a large barge-mounted laser prototype system, as reported by the Army Waterways Experiment Station (WES), a Corps of Engineers facility at Vicksburg, Miss.

The problem being attacked is one of tremendous proportions, which has successfully resisted nearly 40 years of continuing control effort, and is of vast ecological as well as navigational importance to the nation.

The beauty turned into a "beast" that bids to become the bitter enemy of environmentalists, by destroying the wildlife of many U.S. waterways, is the water hyacinth. Research efforts to control this proliferous beauty—a single plant can produce 1,200 offspring in four months—have proved persistently frustrating to scientists.

Dynamite spreads the plants. Burning is futile. Chemicals have limitations because of possible adverse effects upon the environment. Mechanical methods are expensive, with no satisfactory way to dispose of the harvested plants; left on the bank, they become stinking masses of refuse, hardly distinguishable from garbage.

As it proliferates, the water hyacinth completely covers the water with huge masses of vegetation. The brilliant green leaves cut off all sunlight from the water beneath. All other aquatic vegetation dies. So, too, does wildlife. Almost no fish or other water animals can survive in the growth.

Water hyacinths grow so densely that they can back up water to contribute to floods. They often clog water supply pumps. They even have been known to pile up against bridges until they help to sweep them away.

To date, the most effective means of controlling this floral pest, which in the Army Corps of Engineers' lexicon is only one of several noxious weeds that infest the nation's waterways, is by careful use of herbicides.

The laser barge method, hopefully, will present a means of effective control, at no risk to wildlife or any other impairment of the natural state of the water in which the hyacinth thrives.

The over-all configuration of the laser prototype system permits it to be transported easily by truck, and readily transferred to a barge for use in water hyacinths areas.

A planned field evaluation program will consist of irradiating isolated plots of hyacinths using six levels of dosage (i.e., intensity). Each dosage level will be applied once a month, so that any variation in effectiveness as a function of seasonality and/or plant age can be determined.

Plants in the test plots will be counted, weighed and analyzed for chemical changes; and plant tissue samples will be taken for histological studies at Athens College in Georgia, where similar studies of results of the early laser experiments were made in 1968–69.

DURING A TOUR of the U.S. Army Engineer Waterways Experiment Station (WES), MG J. W. Morris, Civil Works director, Corps of Engineers, examines results of a laser beam directed on a brick. The prototype system was demonstrated before being sent to a water-hyacinth-infested area to test its effectiveness in ridding waterways of the plant. COL Ernest D. Peixotto (right), WES director, and W. G. Shockley (center), chief, Mobility Environmental Systems Lab, directed the barge laser research.

The field evaluation program will be conducted in an area south of New Orleans, La., and will extend over a 6- to 7-month period coinciding with the growing season of the water hyacinths.

The prototype configuration uses a mixture of 57 percent helium, 39 percent nitrogen and 4 percent carbon dioxide circulating through the tubes in which the laser action occurs. About 4,000 watts of infrared radiation is concentrated in a ½-inch coherent beam. This intense beam is then spread out by a mirror system and directed against the water hyacinths.

Radiation produced by this method is completely harmless to animals and man. The heating coil of an ordinary electric kitchen range produces radiation having the same wavelength as the laser. The only essential difference is that all the laser radiation has a wavelength of 10.6 micrometers, while kitchen range radiation has a mixture of wavelengths.

Dr. Ralph A. Scott Jr., in 1968–69 the chief of the Corps of Engineers' Aquatic Plant Control Program, filed a patent application during that period for "Use of Laser Energy for Plant Eradication and Selective Control." He signed a license granting exclusive use to the government on a royalty-free basis.

Preliminary tests were conducted with the cooperation of research scientists at Redstone (Ala.) Arsenal. Using the powerful laser in the Physical Sciences Laboratory, they established the feasibility of the concept. This was explained in Dr. Scott's patent application disclosure as:

"The method can be modified by selection of the proper laser energy so that weed control can be both on land or at the water surface, and also below the water surface for control of suspended and bottom-rooted plants."

Dr. Scott then estimated that development of the most desirable prototype equipment "may be one or two years away," and proposed that the system configuration be designed for mounting in a boat or carried by a low-flying aircraft skimming the water. He will receive a patent award in ceremonies scheduled Dec. 18, at the Office, Chief of Engineers.

The laser is not intended to be used as an exclusive control system, regardless of how successful the prototype equipment may prove in the experimental program. Rather, it will be complementary to techniques now being used, and will be applied in specific areas where conventional techniques may be environmentally unacceptable.

An extensive research program directed to development of effective control methods for water hyacinths and other noxious weeds in inland waterways was started in 1934 by the Army Corps of Engineers—following recognition by Congress of the growing seriousness of the problem.

Some control of the hyacinth comes through structures designed to keep it out of the main waterways. Other structures are intended to keep the plant in the main river current, so that it drifts out to sea, where it self-destructs in salt water. Such measures, however, are effective in only a small percentage of places, Army engineers report.

Another concept of control is through biological means—but the hyacinth has no important natural enemy in United States waters. The danger to economic plants by introducing insects or fish to attack the plants is too great to consider without extensive research and careful testing. However, searches are being made in South America and Asia to find natural enemies and determine their effectiveness as control agents.

In the early laser experimental work, which led to the assignment of prototype equipment

development responsibility to the Waterways Experiment Station, scientists at a number of Army R&D facilities cooperated.

Among them were Dr. Gilford G. Quarles, chief scientific adviser to the Corps of Engineers; Dr. Thomas A. Barr and Buford Jennings, who had key roles in experimentation at Redstone Arsenal; Dr. Harold Gibson of the Harry Diamond Laboratories, Washington, D.C.; and Edwin N. Myers, then a staff assistant for electronics components of lasers, infrared and night-vision devices in the Office of the Director of Defense Research and Engineering.

How did this Beauty and the "Beast" story start? Very innocently, as do most of the beauty and the beast fictional creations. The water hyacinth is not native to the United States. At the New Orleans Cotton Exposition of 1884, Venezuela contributed a magnificent floral display, which included a floating plant that was acclaimed as one of the most beautiful blossoms in the world.

Nearly everyone, it seemed, wanted one of these dazzling plants to ornament their garden pools. Once released, the immigrant plant naturalized, and spread with incredible speed.

Within a few years, the water hyacinth had infested all the main bayous and streams of Louisiana, and had spread into Florida and other southern states to such an extent that Congress was requested to take action.

The U.S. Army Engineers made a report on the problem in 1898, and operations to control this plant began in 1900. Not until 1934, however, was the current Corps of Engineers research program started.

In fiction, most beauty and the beast stories end happily, with the beast rightfully destroyed. The Army Engineers hope their real life version will yield similar results.

Boron Compound Produced at Low Temperatures

Low-temperature processing has produced high-boron compounds (CaB_6, SiB_6) of theoretical density goals for potential lightweight ceramic armor applications, as reported recently by the U.S. Army Materials and Mechanics Research Center (USAMMRC), Watertown, Mass.

Dr. Sunil K. Dutta has produced fully dense specimens at a temperature of 1600°C., which is lower than that required to densify boron carbide. The density of silicon hexaboride (SiB_6) is 2.43 g/cc with a hardness of 2300 kg/mm^2; that of calcium hexaboride (CaB_6) is 2.45 g/cc and a hardness of 2740 kg/mm^2.

The die material was principally graphite, but a Grafoil liner and spacers were used to separate the powders to be hot pressed from the graphite plungers in the die. The use of Grafoil liners and spacers minimizes a carbon reaction with the boride powder to be sintered.

Dr. Dutta believes that the significant advantage is that this material can be fabricated to theoretical density by hot pressing at a temperature 600°C. lower than that required to densify boron carbide. This material has a substitute application as a lightweight armor material, like boron carbide.

An examination of the microstructure in calcium hexaboride revealed the presence of Ca-rich oxide as second phase at the grain boundaries, while silicon hexaboride consists of a polyphase structure with Si, Mg and SiB_4 in it.

Further in-depth study on material synthesis and characterization associated with elimination of second phase at the grain boundaries, Dr. Dutta has indicated, could lead to a further increase in ballistic performance without any increase in areal density. Moreover, the production of this material would be more cost-effective because of its low-temperature processing capability.

Natick Relocating Huge Solar Furnace to White Sands Missile Range

Capable of intensifying rays of the sun into temperatures approaching those generated by a nuclear blast, the nation's largest solar furnace is being moved from Natick, Mass., to White Sands Missile Range, N. Mex.

Built by the Army in 1957, it was operated first by the U.S. Army Quartermaster Research and Engineering Command and later by the U.S. Army Natick Laboratories. It was used to study flammability of clothing and life survival systems in a thermal radiation environment.

Slated to be dismantled, transported and reconstructed at WSMR before May 16, 1973, the furnace will be used to study effects of thermal radiation on Army equipment, with emphasis on electronic circuits, transistors and other missile components.

Composed of four major components—a heliostat, a concentrator, an attenuator and a test chamber—the Natick research tool fills a space about 45 feet high and 125 feet long. It can focus 5,000° F. of thermal radiation energy onto a 4-inch-diameter area of steel. The largest known furnace, in Odeillo, France, can focus 7,000 degrees.

The heliostat is a slanted platform about 35-feet square, bearing 355 optically adjusted quarter-inch-thick mirrors. They reflect the sun's rays over and around the box-shaped test chamber, through the attenuator, onto the concentrator. The heliostat rotates on a radar platform and, because of its great latitude of adjustability, can obtain usable solar radiation through most of a normally clear day.

The attenuator is a network of louvres, which can be opened, closed, or left slanted to control the flux of thermal rays passing from the heliostat to the concentrator.

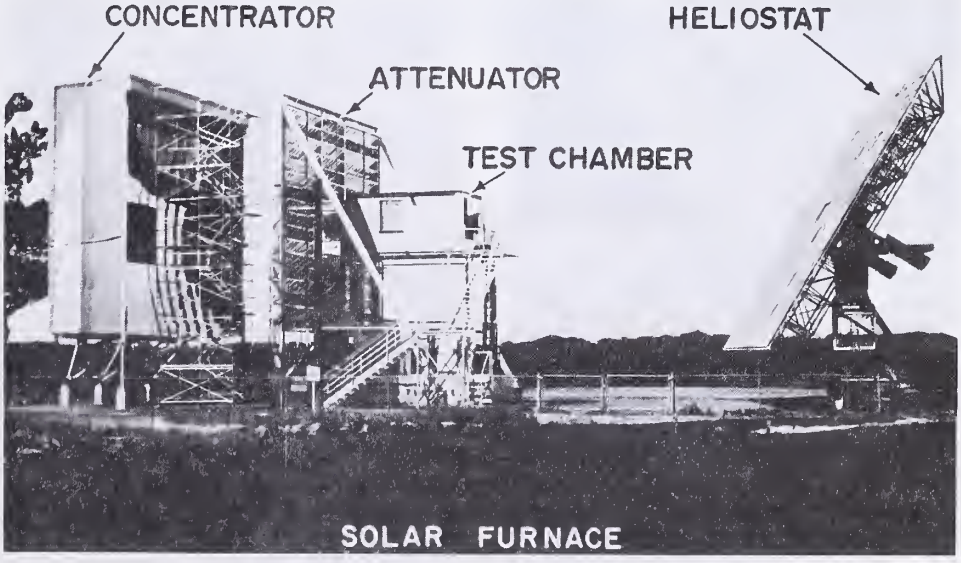
Concave, rectangular mirrors—180 in all, with an approximate focal length of 35.8 feet each—comprise the concentrator surface. Each mirror is adjusted so that a convergent, intensified beam is focused into the 4-inch circle in the test on the heliostat side of the attenuator.

All controls and the laboratory testing equipment are housed in the test chamber. There the objects to be tested are subjected to short, shutter-controlled exposures of high thermal flux.

The exposure process works similarly to a camera exposure, but there are two shutter devices. A fast shutter interrupts the leading edge of the thermal pulse and a water-cooled slow shutter moves up in front of the fast shutter to prevent the latter from burning. While the attenuator controls intensity of radiation, the shutters control time of exposure.

The furnace will add another element to the WSMR nuclear environment created by the Nuclear Weapon Effects Division's linear reactor, electromagnetic pulse generator, gamma range and fast-burst reactor.

The project to relocate the solar furnace, which has been advertised for bidding with a lower limit of $100,000 and an upper limit of $500,000, will be supervised by the Fort Worth District Engineer. Potential bidders should contact the Fort Worth District Engineer at 817-334-2130 for plans and specifications.



WSMR Studies Tropic Effects on Army Materiel

Simulated rain forest vegetation and tropical climate of Panama have been brought to the arid desert of White Sands Missile Range (WSMR), N. Mex., to play a part in research and development.

In a 20 x 8-foot building called the Tropical Chamber, a miniature forest is being nurtured. Flourishing with plants, from tropical ferns to orchids, the chamber is maintained at a constant 86-degree temperature while the humidity ranges from 75 to 95 percent.

Electric heaters equipped with fans maintain the winter temperature, and automatic water sprinklers turn on when humidity dips.

Staffed by personnel of the Environmental Branch, Applied Mechanics Division, Army Missile Test and Evaluation Directorate, the tropical chamber is used to provide data for two specific tests.

First, scientists want to determine residual effects of fungus on Army material when it is periodically cleaned during normal inspection and maintenance schedules. The second goal is to determine effects of fungus when it builds up on materiel in areas inaccessible for periodic cleaning.

Missile components tested vary from minute transistors to 18-foot lengths of cable. Microbiologist Oscar Calderon, who is in charge, said the tests were originally conducted in the Panama Canal Zone.

Calderon noted that several years ago 11 missiles were subjected to a tropical environment for periods of one to five years, then returned to WSMR for inspection and evaluation. Research showed they were attacked by 79 fungal species and six bacterial groups.

Moving missiles and associated equipment from various overseas tropical areas to WSMR for detailed microbiological evaluation frequently produced disappointing results, Calderon said, explaining:

"We often found that the missiles and their components had dried to such an extent during shipment that they were almost worthless for microbiological study when they reached our labs."

In spite of time and dehydration problems, researchers isolated more than 250 species of microorganisms on missiles returned from Panama, Korea, Germany and the U.S.

To save money and overcome the dehydration problem, officials decided in 1970 to "bring the rain forest to the missile range."

A tropical chamber greenhouse and controlled chamber (stainless steel box) were built at the range and study of microorganisms on missiles and related equipment began.

From initial studies at WSMR, Calderon and his colleagues discovered that the presence of microorganisms in missiles formed "living bridges" across electrical components which caused shorts within the electronic system. Other organisms were found to produce waste products (organic acids) that caused metals to corrode in a very short time.

Calderon and his staff, which includes a microbiologist and two New Mexico State University cooperative students who work at the range for six months and return to school for a like period, isolated and identified many microorganisms responsible for degrading specific materials.

Presently, a program is being conducted to determine the ecological equivalent forms that degrade similar materials in the greenhouse and in real tropical environments.

The immediate goal of the tropical chamber testing at WSMR is to improve the reliability of U.S. missiles and other armament in the Army Materiel Command (AMC) arsenal.

New Mexico State University co-op student Mike Delano, employed part-time at White Sands (N. Mex.) Missile Range, inspects orchid in Tropical Chamber.

R & D NEWS

USAMMRC Establishes Laser-Optics Facility

Development of a Laser-Optics Facility at the U.S. Army Materials and Mechanics Research Center, Watertown, Mass., was announced recently as a part of the Mechanics Research Laboratory.

The facility will be used for experimental studies required to develop advanced procedures for the utilization of laser technology for dynamic strain, displacement and density measurements related to the transient response of advanced material and structures under blast and impact load.

Optical techniques include laser holography, interferometry, moire and scattered light photoelasticity. Measurement procedures developed are applied in structural dynamics, battle damage and composite joints as well as in penetration and impulsive loading studies of composite materials.

Basic concepts being examined include pulsed laser holography, interferometry and moire patterns analysis. High-speed photographic procedures and special optical facilities will be used to develop advanced techniques applicable to the measurement of transient strains, displacement, and density (gas pressure) variation.

Successful adaptation of laser-optical methods to the measurements of transient structural response has been achieved. Transient large displacements of nonplanar structures, which up to now could be measured only at a single point or at a few discrete points, can now be measured over the whole field by using shadow moire techniques.

Analysis of the pictures with a microdensitometer provides quantitative information on the deflections of doubly curved shells under transient loads produced in a shock tube. The method offers the following features:

- Nothing is attached directly to the shell, thus avoiding interaction with the response of the shell.
- Since the moire fringes are purely optical interference phenomenon, there is no drift or lag in their response to the event.
- The method permits whole-field viewing of the deformed shape of the shell.

Transient uniaxial strain measurements of objects under blast loads are being measured using contact moire procedures that produce a continuous recording of strain in the specimen.

To enhance uniaxial strain measurement, the speckle pattern interferometric method is being studied.

In that rigid body motion will not influence the fringe pattern, this is more useful than ordinary moire methods. Sensitivity is greater, allowing measurement of smaller strains, and more advantageous also in that no grating is bonded to the surface. Instead, the natural surface pattern of the specimen is used.

The suitability of laser interferometric and holographic interferometric techniques is being examined for the measurement of transient variations in gas densities during the approach and contact of shock pulses with a structure in a shock tube.

A 6-inch-square transparent shock tube is to be used to generate an incident shock or rarefaction wave. From the results, a qualitative definition of the wave front shape during contact with a structure is obtained.

The eventual goal is the complete 2-dimensional quantitative definition of the pressure-time loading on a structure, which includes the mutual interactions of the structure and the wave.

Anthony Stramondo, a physicist and recent graduate of Northeastern University, is the principal investigator in this research. He entered AMMRC under the cooperative work-study program and is working towards an advanced degree at M.I.T. Contributing to this research are Alan H. Katz, engineer in applied mechanics at the AMMRC, and Prof. Fu-Pen Chiang, a consultant from the State University of New York.

ECOM Initiates 24-Hour Service Call As Aid in Solving Equipment Problems

Users of United States Army Electronics Command equipment who have problems can get fast relief by calling 201-532-4543 or Autovon 992-4543.

The Directorate of Product Assurance, USAECOM, has arranged for 24-hour service at that number. From 8:00 a.m. to 4:30 p.m. a quality assurance specialist takes calls; after 4:30 an answering machine gives tape-recorded instructions and records the inquiry or complaint.

Either way, the quality assurance specialist finds out who can best answer the question and has that person respond to the caller.

The service has been tested several months, is working well, and eventually may be proposed for Army-wide use.

Edgewood Eases Eye Examination Through Visual Evoked Response

Visual Evoked Response (VER), an eye examination procedure introduced in 1970 at Edgewood (Md.) Arsenal, is now used regularly in more than a dozen eye clinics throughout the United States.

VER is expected in coming years to become a standard part of eye examinations, since it obviates the need for vocal response to the doctor. The technique was developed by MAJ Roy H. Rengstorff, a research optometrist with the U.S. Army Biomedical Laboratory at Edgewood, and Dr. Frank H. Duffy, a Harvard neurologist assigned to the Lab.

During routine eye examinations, the examiner flashes signs in an illuminated projector and asks the patient to tell what he sees as various size characters are exposed. Based on responses, the doctor prescribes lenses or treatment that will restore vision as close as possible to what is considered normal.

Vocal response, however, is not always possible while examining incapacitated or retarded persons, or those too young to describe what they are observing in the spectrascope.

The idea of developing a nonverbal eye examination was suggested in 1967 when it was discovered that electrical brain waves, which indicate how well a person sees, could be recorded and interpreted. It was learned that the intensity of the brain wave depends upon the sharpness of the visual image; a blurred or out-of-focus image results in a weak wave.

MAJ Rengstorff and Dr. Duffy then addressed the problem of applying this newfound technique to practical eye care. The research that resulted was an outgrowth of the basic work being done with brain waves in the neurophysics and experimental psychology sections of the arsenal's Biomedical Laboratory (then known as the Medical Research Laboratory).

For almost a year the two men used a control group of soldiers (those whose vision characteristics were known from conventional examination) to verify the accuracy of the new process and to trim the procedure to its simplest form.

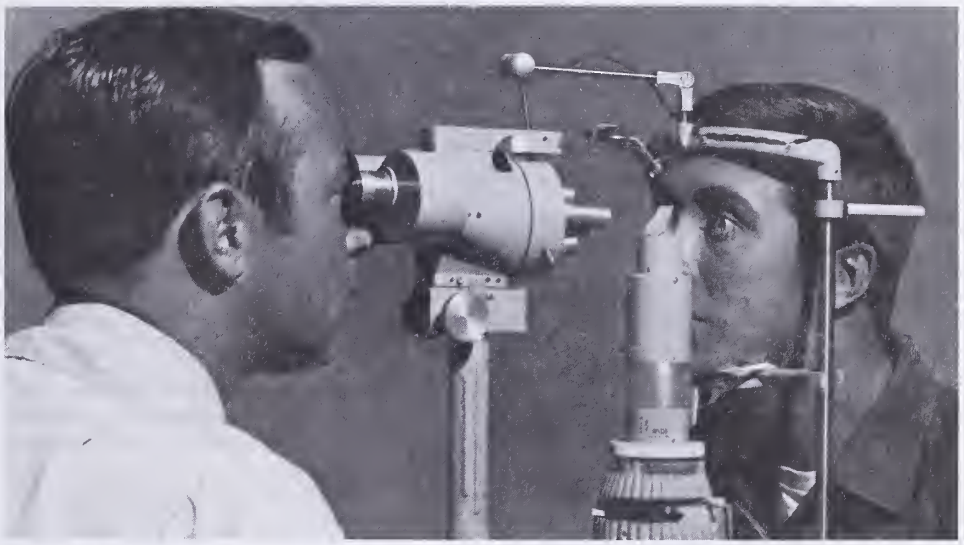
The procedure they developed is simple, painless and accurate. A small piece of wire with a padded tip is held against the back of the scalp with a gauze strip tied around the head. Two other small wires are attached to the earlobes and the examination begins.

A series of patterns is flashed on a screen 20 feet away from the subject and he merely looks at them. The brain waves are stimulated by the patterns, each of which appears on the screen for only a fraction of a second. Responses go into a digital computer which averages the intensity of the waves and records the average wave on a printout.

By holding different lenses in front of the eye and checking the printout, the lens that gives the best image can be determined—without the subject saying a word.

"The best part of the technique is that we can now determine how well an image is being received in the brain," says MAJ Rengstorff. "Even though the eye itself may be functioning properly, there may be a break or an impairment somewhere between the eye and the brain."

The value of the VER procedure in diagnosing vision problems has been satisfactorily demonstrated.



SLIT LAMP is used by MAJ Roy H. Rengstorff (left) in a conventional method of checking focus of a patient's eyes during test to verify accuracy of a new procedure of VER.

Some children believed retarded have been found normal except for an acute sight handicap. In some instances, the defect was so severe that hand-eye coordination was impossible; thus the otherwise normal child was thought to be retarded.

This type of condition cannot be properly diagnosed and treated with the conventional subjective eye examination because of the necessity for vocal response. Using the VER method, doctors have been able to pinpoint the child's problem and correct it.

"We spent long hours getting the procedure down so that it could be practically applied," says MAJ Rengstorff. "Now that it is being put to actual use in clinics, it can be perfected so that it becomes a more useful tool. It won't do away with the subjective tests, of course, but by using it in conjunction with these tests we get a more reliable result."

Further development of VER is now in the hands of others, but the research of MAJ Rengstorff and the Biomedical Laboratory is continuing. While pursuing his PhD in physiological optics at Ohio State University, he is researching the effects of different environments on the enzymes within the cornea of the eye. Results expected to have particular significance in the improvement of contact lenses.

A native of Teaneck, N.J., and a 15-year Army veteran, he received BS and optometry degrees from the Illinois College of Optometry and his master's degree from Pacific University.

MAJ Rengstorff is a Fellow of the American Association for the Advancement of Science, the New Jersey Academy of Science, and the American Academy of Optometry (AAO). He also is a Diplomate of the AAO.

MAJ Rengstorff is the author of more than 45 technical papers and has lectured before professional societies in Denmark, South Africa, Switzerland and Germany. He joined the Biomedical Laboratory in 1967 and received the Meritorious Service Medal in 1971.

Accelerated Development Reliability Goals Viewed

Recommendations of a high-level Panel on Acclerated Development of Reliability were discussed at a recent symposium to promote reliability growth, held at Aberdeen (Md.) Proving Ground by direction of GEN Henry Miley, CG, Army Material Command (AMC).

Chaired by Jack Hope of the White House staff, the panel consisted of Prof. Gerhard Reethof, Pennsylvania State University; Dr. Steven Webb, McDonnell-Douglas Astronautics Co.; S. J. Lorber, director, Quality Assurance, AMC; O. P. Bruno, Army Materiel Systems Analysis Agency (AMSAA); and Dr. Craig M. Crenshaw, chief scientist, AMC.

LTG Robert E. Coffin, Deputy Director of Defense Research and Engineering (Engineering and Management), gave the after-dinner address, in which he stressed the importance of new methodologies to effect significant improvement in material design, production, procurement and usage life cycle.

The objective of extension of the life cycle has emphasized the need for major advances in standards for materiel reliability, availability and maintainability, the high-priority Department of Defense RAM Program.

Bruno stated that the requirements for reliability and performance parameters are highly demanding and the combat and climatic environments invariably cover broad spectrums. He said that "procedures for management of resources, funding manpower, contracting and time scales present formidable management tasks."

Suggested as one avenue for improvement is a developmental system known as "reliability growth modeling." Potential advantages would include:

- Placing in perspective the relationship of requirements to materiel acquisition stages.
- Increased attention on quantitatively tracking the acquisition process, and corrective action techniques.
- Aiding in allocation of resources in meeting goals with constraints.
- Establishment of capabilities for projecting reliability growth in the decision-making process.

WSMR Evaluating Huge Balloon Atmospheric Study Data

Data from an experiment designed to measure the stratospheric composition involving the largest balloon ever fabricated in the United States—taken in the 25- to 31-mile altitude area in the most comprehensive simultaneous sampling yet attempted—are being analyzed at White Sands (N. Mex.) Missile Range. The evaluation is expected to extend to February 1973.

Purpose of the experiment was to measure detailed time and space variations in atmospheric composition and the related variations in the meteorological parameters of temperature, pressure and density at times of darkness, sunrise and daylight.

The primary instrumentation payload included an ultraviolet photometer, a cryogenically pumped quadrapole mass spectrometer, positive ion sensor, Lyman alpha lamp for production of nitric oxide ions, dual chamber atmospheric sampler, chemiluminescent ozone sensors, bead thermistor temperature sensors, thermal conductivity pressure gauges, Geiger tube cosmic ray detector, and aluminum oxide water vapor sensors.

In addition, magnetometer and pendulum sensors were utilized to determine attitude of the payload, reeled down to 1,300 feet below the balloon when it reached an altitude of 15 kilometers (9.375 miles).

A secondary payload consisted of an additional aluminum oxide water vapor sensor and a balloon skin temperature sensor mounted on the valving plate at the top of the vehicle.

Harold N. Ballard, project manager for WSMR's Atmospheric Sciences Laboratory (ASL), said an initial check of the data indicates that all sensing instruments functioned properly and major objectives of the experiment were met.

The experiment was a cooperative effort of ASL (an element of the U.S. Army Electronics Command), Air Force Cambridge Research Laboratories, and Sandia Laboratories, Albuquerque, N. Mex. The laboratories were supported in a contractor capacity by the University of Texas at El Paso, Pennsylvania State University's Ionospheric Laboratory, and Panametrics, Inc., of Waltham, Mass.

LARGEST BALLOON ever fabricated in the United States, used in a recent experiment at White Sands (N. Mex.) Missile Range, is shown at float altitude of 164,000 feet over the San Andres Mountains about three hours after launch. The balloon measures 500 feet in diameter and has 38 million cubic feet of helium.

AMMRC Assumes Management Of 4 DoD Information Centers

The Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass., recently assumed technical management of four Department of Defense (DoD) Information Analysis Centers.

They are: Machinability Data Center, Metcut Research Associates, Inc., Cincinnati, Ohio; Mechanical Properties Data Center, Belfour-Stulen, Inc., Traverse City, Mich.; Metals and Ceramics Information Center, Battelle Memorial Institute, Columbus, Ohio; and Thermophysical Properties Information Analysis Center, Purdue University, West Lafayette, Ind.

Regarding the Army Materiel Command acquisition, AMMRC Director Dr. Alvin E. Gorum said: "It places the management and supervision of these centers in a logical place, where the product can be effectively monitored and operating changes easily accommodated.

"The Army Material Command (AMC) has national responsibility for development of unique weapon and vehicle systems, which require the latest materials information available to provide the most advanced design and engineering effectiveness."

The AMMRC engineers and scientists will review all technical publications produced by the centers, which collect, analyze, correlate and publish research results from worldwide sources in their respective fields of interest.

In a typical year, the centers handle more than 1,300 technical inquiries and more than 2,500 bibliographic inquiries. They also produce handbooks and data books, and conduct state-of-the-art surveys.

The Mechanical Properties Data Center alone has more than 900,000 test results on 4,000 structural metals and alloys on file, and 10,000 books, government reports and journals. The entire collection is indexed to provide computer access on the basis of alloy, test type, processes, test environment and related variables.

The AMMRC is responsible for managing the AMC research and exploratory development program in materials and mechanics, and for conducting technological programs in materials and mechanics as used in Army materiel. In April 1972, the AMC also designated the AMMRC as the lead laboratory for solid mechanics technology.

R & D NEWS

EPA Studies Wastewater Purification for Lakes

Feasibility of restoring lakes dying from pollution, by removing nutrients from incoming municipal wastewater to retard growth of destructive algae, is being demonstrated by the Environmental Protection Agency (EPA).

The project began in October at Shagawa Lake, an area of about 2,340 acres near the town of Ely in northern Minnesota. A $2.3 million advanced waste treatment facility is designed to remove more than 99 percent of the phosphorus in wastewater from Ely's secondary sewage treatment plant.

The facility will be managed and operated by EPA personnel for the first three years at a cost of approximately $575,000 annually, for research purposes, after which the city will assume full responsibility for operation.

Design of the lake restoration program and the new water treatment facility are based on a study begun at Shagawa Lake in 1966 by the National Eutrophication Research Program at EPA's Pacific Northwest Water Laboratory in Oregon.

The study included operation of a 28,000-gallon-per-day pilot treatment plant, complete with 150,000-gallon floating test basins in the lake, to learn the effects of various degrees of advanced treatment on the receiving lake water.

Dr. A. F. Bartsch, director of EPA's National Environmental Research Center (NERC) at Corvallis, Ore., said, "The Ely project is the only lake restoration demonstration of its kind anywhere in the world.

"Although there are several other tertiary plants currently in operation, this is the first attempt to restore a lake while continuing to discharge highly treated wastewater into it."

Although some of the existing tertiary treatment plants are designed to head off pollution at lakes still pure, he explained that the Ely project is aimed at reversing the eutrophication process in one already affected.

Although Ely has had a municipal sewage system since 1901, the effluent has always been discharged into Shagawa Lake. The city has had a secondary treatment system since 1954 to convert organic materials in the wastewater into a form that can be separated before the water enters the lake.

Secondary treatment, however, does not remove enough of the phosphorus that stimulates the growth of algae and other plant life in problem lakes and streams. At the Ely facility, phosphorus will be removed by chemical treatment, settling and filtration.

Wastewater from Ely contributes only two percent of the total water flowing into Shagawa Lake, but it is the source of more than 70 percent of the lake's phosphorus content. Most of the remaining phosphorus comes from natural sources and septic tank.

The waste water from Ely's secondary treatment facility has a phosphorus concentration of five parts per million—a level which stimulates rapid algae growth in the lake. By processing wastewater through the pilot tertiary system, the EPA scientists reduce the concentration to a tolerable level having negligible effect on algae growth.

If the full-scale tertiary plant functions as well as the pilot facility, only 150 pounds of phosphorus will enter the lake each year via treated Ely wastewater discharge instead of the present 15,000 pounds. No other tertiary treatment plant, on any scale, has yet achieved this level of phosphorus reduction.

It is anticipated that the Ely project will provide a model applicable to sewage treatment operations in virtually every state.

The EPA has also begun a nationwide survey to learn which of some 1,200 additional lakes with similar waste emission problems could benefit from tertiary treatment.

'An Army Advances on Its . . .'

NLABS Respond to Field Ration Needs By Developing Flexible Food Packages

PROTOTYPES of NLABS-Swift flexible food packages, under development at Swift & Co.'s Oak Brook, Ill., R&D Center.

In a combat area a forward observer, lying prone on the ground, feels hungry. Carefully rolling over, he reaches into his pocket and withdraws a 4½ by 7-inch package, which he opens with his fingers. Inside are four frankfurters.

After he has eaten, he crumples the empty package into a small wad that he stuffs deep into a clump of bushes, where it is unlikely an enemy patrol will see it. The package was not uncomfortable in his pocket while he was lying on it. The frankfurters are tastefully fresh.

Being produced experimentally on a completely automated production line at Swift & Co.'s Oak Brook, Ill., Research and Development Center, at a rate of 30 packages a minute, the frankfurters packet is one of several flexibly packaged field ration items under development by the U.S. Army Natick (Mass.) Laboratories to satisfy rigorous demands.

Research and development effort is aimed at a reliably wholesome, flexible packet of food that is lightweight when carried in a soldier's clothing and is noninjurious when he falls or troublesome when he has to crawl in a combat environment.

Suitable packaging materials are now available, product acceptance and stability of the rations have been established, durability of the packaging has been verified, and its functional advantages have been confirmed. It is anticipated that eventually the flexible packages may be marketed in the neighborhood grocery store.

Initially the most serious problem during development was a failure rate of 0.3 percent at the point of issue. Some of the rejections, it is admitted, may have been the result of overcautiousness rather than functional failure of the package.

A major problem difficult to solve was the in-plant handling, filling and sealing of the packages, rather than the laminated package itself. An infrared scanning device was developed to inspect packages. The prototype machine works at the rate of a package every second, automatically rejecting defectives.
packages.

The flexible food package permits greater variety in contents—such as slices of roast beef or fruit cake—than the conventional can, is not subject to corrosion, and generally has a longer shelf life than a can.

Your neighborhood grocer may put damaged cans in special "bargain" bins, hoping that customers will buy them before they begin swelling as the contents spoil. The flexible package is not prone to this type of spoilage.

The flexible packages are designated as components of Meal, Ready-to-Eat, Individual. Six selected items are generally representative of all 17 items that will become meal components: fruit cake, ham and chicken loaf, pineapple in syrup, frankfurters, beef steaks, and beef stew. Production began on Aug. 8, 1972.

The complete run of 50,000 of each of the six products is scheduled to be completed by Dec. 31, 1972.

Thickness of the package varies from ⅝ inch to ¾ inch depending on the contents. Reliability thus far is 7 failures in 50,860 packages, better than for conventional cans.

The contract to produce the flexible package was given to a consortium headed by Swift & Co. and including the Pillsbury Co., Continental Can Co., Rexham Corp., and FMC Corp. The packer, the packagemaker, and the equipment manufacturer will be working together for the life of the project.

Phase I of the project, which was completed in mid-1970, called for paper, laboratory, and bench model analyses. The result of Phase I was a determination that the project was feasible and that all 17 of the proposed food products could be produced with various combinations of 4 fillers and 4 nozzles.

Phase II, still in progress, involves production line techniques for the six typical foods. Meat-based items, beans in tomato sauce, and pineapple in syrup all required minor modifications in the line to establish flavor and weight standards, particle or piece size, rheology, optimum fill temperatures, number of filling steps, and thermoprocess criteria.

The bakery items were more tricky, presenting three particularly difficult problems; head pressure differences in the water cook retort; need for a temperature program to allow leavening, structure setting, and sterilization at the proper temperature and in the required interval of time; and a retort procedure to allow a slightly higher pressure inside the package during cooking when lot to lot pressure was found to be precisely 2 psig. higher than retort pressure. The solution was to put a sample of each batch of dough in a special can and then monitor the pressure in both the can and the retort.

An early discovery during the production set-up was that the pouches can be transported in a carrier very much like a tobacco can in size and shape. The carrier controls the position of the pouch through vacuumizing and closure sealing, becomes a component of the retort rack during processing, eliminates the handling of the pouch between operations, and permits use of a modified standard vacuum closing machine.

The package is a laminate composed of a 0.5-mil layer of mylar, a 0.35-mil layer of aluminum foil, and a 3.0-mil layer of modified polyolefin. It is sealed at 450° F. by a half-second pressure of 40 psig. Even with relatively solid items such as frankfurters or beefsteak slices, the package can be sealed routinely without significant wrinkles.

Twelve patent applications for innovations in the project have been submitted by the development team members, involving the concept of carriers in production, filler nozzle designs, process control techniques, and retort control methods.,

NLABS researchers report that the flexible food package has been proven practical, industry has been shown how to produce it on a production line, and the combat soldier will receive tastier and more convenient rations.

NLABS, Industry Discuss Flexible Food Packaging

Flexible packaging for heat-processed foods was considered at a Nov. 9-10 conference in Chicago sponsored jointly by the U.S. Army Natick (Mass.) Laboratories (NLABS) and National Research Council, Washington, D.C.

The purpose was to explain the significant production capability advances made and to interest the commercial food industry in the process developed by NLABS scientists after several years investigative effort. U.S. Army Material Command Deputy for Laboratories Dr. Robert Dillaway explained the need for flexible packaging for heat-treated rations.

NLABS Commander BG John C. McWhorter gave the welcoming address.

An explanation of the research and development effort was presented by NLABS scientists Dr. Rauno A. Lampi and Frank J. differences in the dough changed the correct pressure.

The solution to the third problem was particularly innovative. The correct in-pouch Rubinate, including the establishing of production reliability goals.

Industrial speakers included Dean Duxbury of Swift & Co. who discussed the contract effort and how the company modifies products to facilitate production; Powell Sam, Pillsbury Co., whose topic was bakery goods in flexible packages; and Alan Corning, Continental Can Co., who spoke on maintaining a reliability in packaging materials.

William Miller of Rexham Corp., James Gee of the FMC Corp. and Gerald L. Schulz of NLABS discussed various aspects of the reliability problem.

Robert F. Froehlke

GEN Creighton W. Abrams

GEN Russell Dougherty

Top Defense Officials, Industrial Exhibits Featured At 18th Annual Association of U.S. Army Meeting

Development of the professional soldier and the future of the Modern Volunteer Army were among the major topics of discussion at the 18th annual meeting of the Association of the United States Army, Oct. 9–11, in Washington, D.C.

Highlighting the climactic banquet was the presentation of the George Catlett Marshall Medal to entertainer Bob Hope. This is the highest AUSA award, presented annually to an individual for "selfless and outstanding service to the United States of America." Hope was the 13th recipient.

Previous recipients of the George Marshall Medal include former Presidents Truman and Eisenhower, former General of the Army Omar N. Bradley, and former Vice Chief, Chief of Staff of the Army and Supreme Allied Commander, Europe, GEN Lyman L. Lemnitzer. Last year's winner was Dean Rusk, former Secretary of State.

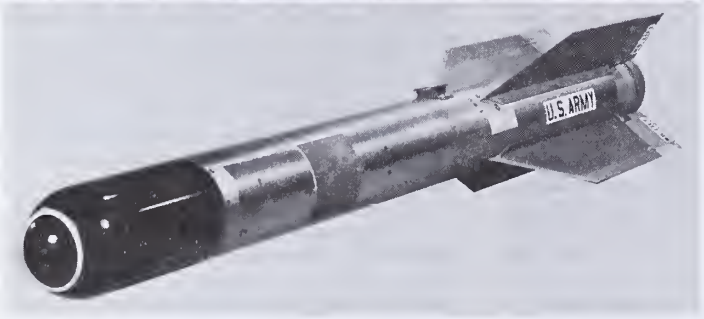
Secretary of the Army Robert F. Froehlke stressed in the keynote address that during the past year his emphasis has been on people problems and equipment needs. He said that the Army should continue to promote men who are young in outlook, vigorous both mentally and physically, and dedicated to serving the nation.

Commenting on the All Volunteer Army, he said "we must place increased emphasis on getting the right kind of people in the right numbers, doing the right jobs. Then we have to instill in them the high morale and discipline that is the mark of the professional soldier.

"With the very future of the Army at stake in our volunteer programs, we are embarked on what amounts to a great crusade. The main potential threat faced by our volunteer force today is public apathy—and the mistaken belief that our country can survive without a strong defense establishment."

Secretary Froehlke said that "one of our problems in building the volunteer Army occurs when the public believes that only lazy and stupid people serve in the Army. The danger is that such nonsense becomes a self-fulfilling prophecy which insures that this kind of man may become attracted to the Army."

He added, "one of our major goals must be to raise the respect and appreciation of our citizens for the Army. To put it



AH-1G Huey Cobra unleashes Army Laser Hornet for a direct hit on an armored vehicle. Photo at left-center shows a close-up.

another way, the Army's image and credibility must be improved as it shifts from war to peace, from a partially conscripted to an all-volunteer force, and from a rapidly expanded Army to a smaller, completely professional Army."

Referring to a recent Human Resources Research Organization study on leadership actions, Secretary Froehlke said findings show that young officers, like most people today, possess definite views about leadership. "In general, the picture that emerges is one of a leader who invites the opinions and suggestions of subordinates but makes his own decisions."

"After he makes his decisions and assigns the missions or tasks, he allows subordinates to do their work without oppressive supervision and to make decisions freely, within their areas of responsibility. He provides subordinates with clear definitions of the performance expected and rewards them on the basis of accomplishment . . .

"The validity of this concept has been borne out time and again as I have talked to young soldiers in the field during my visits. They want to be told why something has to be done, receive the truly necessary command guidance, and then they want to be left alone to do it. There has been a lot of discussion about this matter in the press, and in and out of the military . . .

"Some maintain that today's soldier doesn't respond to orders as did his counterparts in other days. That is just plain nonsense. When it comes to motivation and respect for leadership, the soldier today responds exactly as his World War II counterpart. Once he is told what is expected of him and why it has to be done—he gets the job done effectively and cheerfully."

David Abshire, Assistant Secretary of State, Congressional Affairs, addressed the AUSA on "National Security in Transition—the Executive and the Congress." He stressed that the defense of the United States should not be considered as an exclusively military responsibility.

Other featured speakers included Edward C. Logelin, AUSA president, who spoke at the annual luncheon and outlined the association's activities during the past year; GEN Creighton W. Abrams, Army Chief of Staff; Dudley C. Mecum, Assistant Secretary of the Army for Installations and Logistics; and GEN Russell Dougherty, U.S. Air Force, Chief of Staff, Supreme Headquarters Allied Forces, Europe, who discussed "NATO in the Seventies."

Over 50,000 square feet of floor space was devoted to Army and industrial exhibits, illustrating the latest developments in the military field.

Included among the more than 80 attractions on display were two full-scale models of UTTAS (Utility Tactical Transport Aircraft Systems).

Another display was the French-developed CROTALE air defense missile system that is a contender for the Army's low altitude air defense mission. In its simplest configuration, CROTALE is a two-vehicle system with a surveillance vehicle and a firing vehicle. Both are tracked vehicles and are air transportable.

Other attractions included the Huey Cobra helicopter, presently in use by the Army, and the Tube-launched, Optically-tracked, Wire-guided missile (TOW). Laser weaponry was represented by the Army Laser Hornet antimissile system, designed for direct and indirect fire against armored vehicles.

In addition to the many exhibits and speeches, the AUSA issued three position papers titled "AUSA Supports the SALT Proposals," "The Arithmetic of Adequacy," and "The Draft and Volunteer Forces—An Update."

Top Army R&D Leaders Briefed on UK Group Program

Activities of the U.S. Army Standardization Group, United Kingdom, have been marked recently by the joint visit of Assistant Secretary of the Army (R&D) Robert L. Johnson and Army Chief of R&D LTG William C. Gribble Jr.

Other highlights have included assignments of four new personnel and the presentation of awards for exceptional performance of duties.

ASA (R&D) Johnson and LTG Gribble were briefed on activities of the Standardization Group and the U.S. Army R&D Group, Europe, covering a broad base of R&D effort in NATO countries.

LTG Gribble presented the Legion of Merit to COL Charles S. Horn, who recently became the senior standarization representative, following a tour of duty as chief of the Individual Soldier Division, HQ U.S. Army Materiel Command. He has a 1948 bachelor's degree from the U.S. Military Academy, and is a graduate from the Army Command and General Staff College.

GEN Gribble also presented the Meritorious Service Medal to LTC Edward E. Chick, now chief of the Materials Branch, Army R&D Group, Europe. Prior to this assignment he was a staff officer under GEN Gribble in the Physical and Engineering Sciences Division and (later) the Laboratory Review Office, HQ OCRD.

COL Horn presented a Certificate of Service and a Letter of Appreciation to John Nevill upon his retirement after 24 years of duty with the U.S. Army Standardization Group, United Kingdom.

During more than 350,000 miles of accident-free driving throughout the UK and the congested traffic in the London area, Neville was responsible for the safety of such distinguished passengers as Generals Mark Clark, William C. Westmoreland and Michael S. Davison.

LTC David C. Davenport has been assigned as research/general materiel standardization representative. In 1969–70 he was with the General Materiel Project Office, Special Warfare Agency, Fort Bragg, N.C.

LTC Davenport has a 1953 BA degree from Virginia Military Institute, a 1972 MA degree from the University of Missouri, and has graduated from the Army Command and General Staff College (C&GSC).

MAJ Gregory T. Ogden has been named as weapons/munitions standardization representative. During 1970–71 he was an instructor and chief, Supply Branch, Logistics Division, U.S. Army Missile and Munitions School.

His academic credentials include a 1959 BA degree in mathematics from Bucknell University and a 1963 MS degree in nuclear physics from the University of Alabama. He is a 1972 graduate of the C&GSC.

MAJ Albert F. Dorris is newly assigned as engineer standardization representative. During 1968–71 he was an assistant professor of engineering at the U.S. Military Academy. He has a 1959 BS degree from the U.S. Military Academy and 1960 MS and 1965 PhD degrees in chemical engineering from the University of Illinois. He is a graduate of the Army Command and General Staff College.

ARMY CHIEF OF R&D LTG William C. Gribble Jr. congratulates LTC Edward E. Chick, Army R&D Group, Europe, after awarding him the Meritorious Service Medal.

Slurry Explosives . . .

Offer Significant Advantages to the Excavation Engineer

By CPT Howard H. Reed

Visitors to an Explosive Excavation Research Laboratory (EERL) field test site desiring to learn about some of the advanced technology might well be surprised to observe what appears to be a large supply of jello being pumped or dumped into a drill hole in the ground.

This is not a harebrained scheme to cushion the rock against the effects of the explosion. Instead, it is a type of explosive relatively new to the military engineer, called a slurry or water-gel.

To comprehend fully the evolution of slurry explosives, one must start with the discovery that by adding fuel oil to pelletized ammonium nitrate, an excellent explosive for production blasts was obtained. As ammonium nitrate was a relatively inexpensive fertilizer, much safer and easier to work with than cartridged dynamites, it soon gained wide acceptance in the drilling and blasting industry.

The ammonium nitrate currently used in blasting is formed into a porous pellet called a prill. A mixture of 94.5 percent AN and 5.5 percent fuel oil was found to be the most efficient explosive and is termed ANFO. The addition of fuel oil increases the energy released by the AN almost three times.

The fuel oil allows all the available oxygen from the ammonium nitrate to be used effectively in the explosion. ANFO normally comes in 50-pound paper sacks, or it may be delivered by a truck-mounted mixing unit, which adds the fuel oil just prior to loading.

Unfortunately, ANFO is not without several drawbacks, including its low density and its hygroscopy (ability to absorb moisture). As more water is absorbed, the ammonium nitrate's detonation properties are degraded until, if enough water is absorbed, no detonation will occur.

Paradoxically, it was found that through the addition of water, with suitable stabilizing agents, and, if desired, gelling agents, not only are most of these problems overcome, but handling of the explosive is simplified.

These water-based slurries or gels vary in consistency from a heavy paste or jelly to a solid rubbery mass, depending on the gelling agents used. The most common agent is a gum, such as guar gum. The gelling agent serves two purposes: (1) it insures a homogeneous mixture by preventing settling of components, and (2) it facilitates handling.

The gelling agent may be added while the explosive is being pumped into the hole. By insuring that the time required for pumping is less than the time required for the gelling action to take place, the explosive will set to its desired hardness in the hole. This allows the slurry to be pumped in a liquid state, assuring that the borehole will be completely filled and that the possibility of voids in the explosive is minimized.

A simple slurry is one in which the fuel oil found in ANFO is replaced with another fuel which is compatible with a water gel. Most commercial slurries consist of an explosive base, such as ammonium nitrate or sodium nitrate, and a fuel, such as carbon, sulfur or aluminum.

Some slurries use high explosives such as TNT as a sensitizer, and these are classified as slurry high explosives. The majority, however, contain no high explosives and are therefore classified as slurry blasting agents.

While slurries were designed primarily as a replacement for ANFO in wet holes —they can be placed in direct contact with water—it soon became apparent that they offered numerous possibilities for explosive formulations.

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SLURRY EXPLOSIVES are versatile agents for the explosive excavation engineer. They can be formulated with various explosive characteristics and in various consistencies. Slurries can be obtained premixed and prepackaged and can be loaded into drill holes by hand (top, left), or they can be mixed on-site and pumped into drill holes using special equipment (bottom, left).

TABLE 1
Measured Properties and Calculated Parameters
Of Representative Cratering Explosives

Explosive	Detonation pressure (kbar)	Bulk specific gravity	Detonation velocity (m/sec)	Impedance (m/sec)	Heat of detonation (cal/g)	Nominal cost ($/lb)	Excavated volume relative to equal weight of TNT[a]
ANFO	60	0.93	4560	4240	890	0.06 ± 0.04	1.0 - 1.1
AN Slurry	104	1.40	6050	8470	730	0.15 ± 0.05	1.0 - 1.2
AN Slurry (2% Al)[b]	60	1.30	4300	5590	750	0.08 ± 0.05	1.0 - 1.2
AN Slurry (8% Al)[b]	66	1.33	4500	5990	1110	0.13 ± 0.05	1.2 - 1.4
AN Slurry (20% Al)[b]	85	1.20	5700	6840	1450	0.20 ± 0.07	1.5 - 1.7
AN Slurry (35% Al)[b]	81	1.50	5000	7500	1950	0.25 ± 0.10	1.6 - 1.8
TNT	220	1.64	6930	11360	1102	0.25 ± 0.05	1.00

[a] That is, "Cratering Effectiveness" as measured by small charge detonations in sand. Absolute cratering performance in terms of volume excavated per pound of explosive depends on the size of the shot, it is less for larger shots. Relative performance, on the other hand, is not as sensitive to charge size.

[b] Slurry blasting agent.

The ammonium nitrate used in ANFO is restricted to prills to insure maximum fuel absorption, but this restriction is unnecessary in slurries. This means that various size ammonium nitrate particles can be used, which permits the densities and detonation properties of individual slurries to be varied.

The material used as a fuel can also be varied. Again, this results in varying densities and detonation properties.

The addition of large quantities of aluminum produces a slurry with very high energy release at moderate detonation pressures. The presence of aluminum lowers peak pressures, but provides higher sustained explosive pressures.

Slurry explosives represent not just one specific mixture with a given set of properties, but a wide range of products with varying explosive properties.

When the EERL began looking at explosive excavation (see feature article with front-cover picture in *Army R&D Newsmagazine,* July 1972 edition), as an economic alternative to conventional excavation, they also began searching for the best earth-moving explosives available. Previous experience with TNT and nitromethane in large-scale cratering experiments revealed that these explosives were too expensive and too cumbersome for use on Corps of Engineers civil works projects as large-scale, earth-moving agents.

ANFO and slurries were being used extensively by civilian industry and, since they appeared to offer definite cost and handling advantages, it was decided to investigate their potential as bulk explosives for large excavation projects.

At EERL's high-explosive test facility, nine commercially available slurries and ANFO were tested in small-scale cratering shots of eight pounds each. Explosives were selected on the basis of cost, availability, energy content, ease of emplacement, and safety and handling limitations.

Table I indicates that both ANFO and slurries proved to be excellent cratering explosives whose effectiveness equalled or exceeded TNT capabilities.

Further tests indicated that an aluminized slurry with its increased energy output was the most effective earth-moving explosive. This type was chosen for use on the first demonstration project for chemical explosive excavation, a 1,370-foot-long channel in Montana.

Aluminized slurries have also been sucessfully used by EERL to create a small boat harbor in Hawaii, to excavate a railroad cut in Colorado and a road cut in Montana, and to blast a channel plug in North Carolina. ANFO has been employed to create two railroad cuts in Colorado and a model spillway cut.

Experimental work in conjunction with the model spillway cut in Oregon has initially indicated that ANFO is superior in a well-jointed basalt to slurries having approximately the same detonation energies but faster detonation velocities. Future projects will be used to evaluate an energetic aluminized slurry, compared to ANFO, to fragment a relatively unfractured massive sandstone.

"So what," our military explosive man says, "that jelly looks pretty messy, and I see you have to use extra high-explosive booster charges to make sure it goes off. Give me old-fashioned cartridged dynamite and I'll blow any rock for you."

True, slurries and ANFO require booster charges, to detonate them, but this also indicates that they are much safer to handle. They have proved relatively insensitive to heat, shock, and best of all, bullet impact. The mere fact that they contain no nitro-glycerine makes them much safer and healthier to handle and store.

These free-flowing explosives are much easier to use in the field. They can be loaded directly by hand or, as we have done on our larger shots, by truck. Most explosive manufacturers have their own mixing and pumping trucks, which can mix and pump either a slurry or ANFO directly into boreholes.

Another advantage that slurries and ANFO enjoy over dynamite is that they readily fill the hole, leaving few voids in the explosive. This ability to couple directly to the rock to be excavated results in a very efficient blast.

So the "jello" we load down-hole is really a slurry explosive that we feel can do the particular job required most efficiently. Investigation of explosive properties is but one of the research areas being probed by the EERL in its program to develop more economical excavation techniques for use in civil works and military engineering projects.

Army RDT&E, Procurement Contracts Top $319 Million

Army contracts for research, development, test, evaluation and procurement of materiel and services awarded during October, each exceeding $1 million, totaled $319,363,146.

Raytheon Co. received the largest award of $102,312,251 for support equipment for the Hawk missile system. Martin Marietta Corp. will be paid $42,451,228 for operation of a GOCO ammunition facility, hardware for the Pershing and Sprint missiles and for the Air Suppression Missile Test Program.

LTV Aerospace Corp. gained a $25,082,472 contract for Lance missiles and ground support equipment, and a $20,554,917 contract with Remington Arms Co. is for operation and maintenance of an ammunition facility. Mason and Hanger Co. was awarded a $11,-456,532 contract and Uniroyal, Inc., a $10,-670,839 contract for operation and maintenance service of GOCO ammunition plants.

Contracts under $10 million. Federal Cartridge Corp., $9,297,670 for 5.56mm ball and blank ammunition, and for operation of an ammunition facility; Radiation, Inc., $7,-440,378 for fabrication and installation of a satellite communication earth station, and for ancillary items; Bendix Corp., $6,719,663 for ST-120 platforms for the Pershing missile;

Cutler Hammer, Inc., $6,485,500 for development of a tactical landing system used in testing of the Utility Tactical Transport Aircraft System; Brown Engineering Co., $6,-013,796 for engineering and technical assistance of the Site Defense Program; AM General Corp., $5,720,400 for M151A2 trucks.

Contracts under $5 million. Stanford Research Institute, $4,565,206 for R&D support and investigation of ballistic missile defense systems and for a study on "Strategic and Theater Force Posture Analysis"; Ingraham Industries, $4,197,093 for M565 metal parts for mechanical time fuzes; Westclox, $3,-998,703 for M565 metal parts for mechanical time fuzes; and

Textron Inc., $3,799,938 for rotary-wing blades for UH-1 helicopters; Chrysler Corp., $3,639,000 for engineering services on 152mm gun launchers for combat tanks; Burroughs Corp., $3,571,107 for a tactical automatic digital switch; Industrial Contractors, Inc., $2,-942,949 for A-1 test stand modifications for space-shuttle engine testing; and

Amron Corp., $2,853,446 for assembly of M433, 40mm dual-purpose projectiles and cartridge cases; Science Application, Inc., $2,709,910 for software validation and verification; ICI America, Inc., $2,571,396 for operation and maintenance of an ammunition facility; M. Kerner Co., $2,570,506 for M170 81mm fin assemblies; and

Chamberlain Mfg. Corp., $2,539,663 for 105mm illuminating projectiles and parts; Philips Broadcast Equipment, Inc., $2,400,000 for engineering services on a night sight for the Dragon missile system; Delta Manufacturing Co., $1,546,284 for M-2 fin assemblies for the 60mm mortar cartridge; Wilkinson Manufacturing Co., $1,533,455 for M-2 fin assemblies; and

General Dynamics Corp., $1,522,920 for Redeye weapons; RCA Corp., $1,500,000 for engineering development models of an Air Traffic Control Central; Lockheed Missile and Space Co., $1,459,260 for equipment and services in support of underground nuclear testing; Norris Industries, Inc., $1,427,822 for 81mm projectile parts; Hercules, Inc., $1,-395,265 for M4 electric blasting caps; and

Talley Industries, Inc., $1,374,957 for 4.2-inch illuminating projectile parts; Kaman Aerospace Corp., $1,369,089 for R&D on the field-repairable/expendable helicopter main rotor blade concept; XYZYX/Parsons, $1,-358,602 for technical logistics data and maintenance data systems documentation for the Safeguard ABM Defense System; and

Kisco Co., $1,356,835 for parts for 105mm M14B4 cartridge cases; Preco Inc., $1,241,210 for platoon boats for floating bridges; Clevepak Corp., $1,225,806 for fiber containers; Singer Co., $1,193,400 for hydraulic actuators for the Pershing missile system; and

SDM Corp., $1,146,400 for electrical equipment for shelters; Hughes Aircraft Co., $1,-122,843 for research on the Air Traffic Management Automated Center concept; and North American Rockwell Corp., $1,024,435, Air Defense Suppression Missile Test Program.

A R I—a new name, a new approach

U.S. Army Research Institute for the Behavioral and Social Sciences termed 'dynamic' program for employment of human factors resources

ARI is the acronym for the U.S. Army Research Institute for the Behavioral and Social Sciences, a new name on the research and development scene since Oct. 1, 1972, when it was activated by General Order No. 30, Office of the Chief of Research and Development, Department of the Army.

ARI replaces the U.S. Army Manpower Resources Research and Development Center. Located in the Commonwealth Building, Rosslyn Circle, Arlington, Va., ARI puts under one unified headquarters all operational R&D endeavors of the Office of the Chief of R&D in the behavioral and social sciences.

As a Class II activity of OCRD, ARI is being built from resources which previously comprised the U.S. Army Manpower Resources Research and Development Center (MANRRDC), the U.S. Army Behavior and Systems Research Laboratory (BESRL), and the U.S. Army Motivation and Training Laboratory (MTL).

In addition, ARI is assuming a variety of missions and functions previously carried out by the Army Research Office, Arlington, Va., and by FY 74 will become the OCRD developing agency for the behavioral and social sciences.

Commanded by COL Robert A. Rooth, ARI represents what is termed "a new, dynamic approach to the employment of human factors R&D resources." As a research center, ARI has a twofold mission.

The first role is to conduct a Technological Base Program (TBP) of basic research and exploratory development. Second is a program of applied research—advanced development—that utilizes the technological base to help Army users solve behavioral and social science problems they have identified. Primary emphasis is placed upon responsiveness to the needs of the Army in the TBP and in the applied research program.

Human factors problems are solicited periodically and carefully reviewed for researchability and potential product utilization. Priorities take into account the immediacy of military need and the research resource availability. Technical Advisory Service is frequently provided to help solve problems where a full-scale research approach is not warranted or applicable.

Substantively, ARI seeks to promote maximum levels of military and civilian personnel performance throughout the Army, support the effective operation of current and future combat and tactical systems, and maintain the proficiency of groups of individuals working as teams.

To the Army user of behavioral and social science research products, ARI can be looked upon as the embodiment of the long-recognized need to examine and be responsive to the totality of a soldier's passage through the Army.

Areas of ARI concern include the process of recruitment and induction or voluntary entry, through basic and MOS (Military Occupational Specialty) training, to joining a unit and becoming a productive and supportive member of the Army team in the field environment.

Two laboratories have been organized to support the Technological Base and the Applied Research Programs to follow the soldier through this "life cycle." (See chart).

In the Individual Training and Performance Research Laboratory (ITPRL), activities will concentrate upon problems of developing, training and improving enlisted manpower. Emphasis is on problems of individual training, distribution and retention.

Leadership selection, training, systems engineering, and career management occupy the attention of another element of the ITPRL, with emphasis upon noncommissioned officer and officer problems. How to increase the soldier's capability to resolve unique personal problems and to adapt to social change is a third broad problem spectrum.

In the Organizations and Systems Research Laboratory (OSRL), the emphasis is upon enhancing effectiveness of groups of individuals working as teams in military systems found in a variety of military environments.

Objectives of the OSRL include the increase of unit skills, maintenance of unit proficiency in the field, and integration of system concepts through analysis of the interaction of man-equipment-procedures under a variety of missions and conditions.

The thrust of the ARI research effort is in the ITPRL, the OSRL, the six technical areas and the three field units. ITPRL includes the individual training and manpower development, leadership performance, and social processes technical areas, and a field unit at Fort Benning, Ga.

The OSRL includes systems integration and command/control, team performance enhancement, unit training and educational technology systems technical areas, and field units at Fort Hood, Tex., and Fort Ord, Calif.

The structure designed into the six technical areas of research provides flexibility to adapt to changing priorities with little loss of momentum. Lateral movement of scientists across areas is facilitated to adapt to changing priorities. Officers who hold advanced degrees in behavioral and social sciences serve as R&D coordinators and staff scientists in each technical area.

Discoveries made in the Technological Base Program serve all six technical areas. Results form the foundation used to solve specific military problems in the applied program. In addition, TBP findings in one area often penetrate significantly into the design and methodology of other ARI technical areas.

Typical for human factors R&D is that accomplishments in the exploratory development phase of the program are followed by an applied program, so that a new operational test battery or a new training doctrine can be developed.

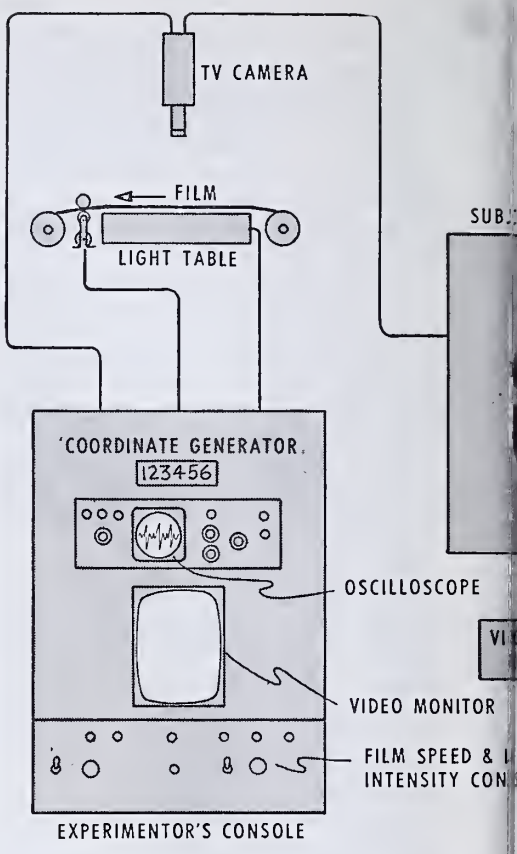


Fig. 1. AN/A

In effect, this translation becomes more feasible with the close association of technological base and applied research units in the same technical area. Applied research or advanced development is designed to provide users with a wide variety of products—new training doctrine, new work methods, selection-assignment specifications, and prediction and evaluation measurement tools for individuals and systems. These products are generally implemented worldwide.

Significantly, ARI's interdisciplinary capability makes it a potentially central figure in the design and evaluation of manned systems.

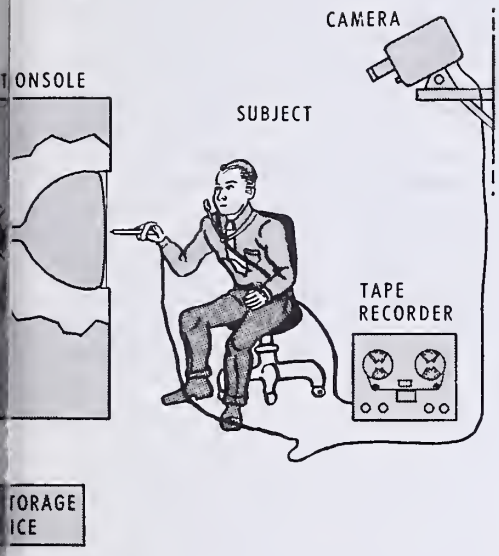
The most recent research approach is the development of a body of knowledge demonstrating how a family of systems can operate in terms of varying systems elements. While the experimental raw materials—personnel, equipment, linkages—are drawn from current resources, the point of reference is the future.

Field and laboratory simulation, systems measurement beds, synthesization of systems or modified portions of systems in which man or a team plays a central or essential role, are all techniques employed in the systems research processes.

The emphasis on systems, teams, enhancing effectiveness of groups of individuals is the concern of the OSRL Systems Integration and Command/Control Technical Area (SICTA).

This area exemplifies ARI's approach in information systems. Its mission is to enhance effectiveness of groups of individuals in support of command/control functions and in the integration of such systems through measurement of total systems performance.

A typical SICTA approach puts the re-



Simulator

search problem into an operations-like, though experimental, setting. Laboratory simulation is both useful and welcome because the actual system may not be practically available for experimental purposes and a systems measurement bed has to be built.

Simulation of this type may even be preferred to the real thing because greater experimental control is generally possible than in actual operations. Some examples are:

Mohawk Surveillance Systems Measurement Bed. Infrared capability is carried by the Army's surveillance aircraft, notably the Mohawk. Research was conducted recently by ARI to assess performance capabilities of airborne sensor operators in a team setting—in determining and identifying tactical targets in dynamic CRT displays of IR sensor returns and providing tactical intelligence information to a potential user.

In Figure 1, the simulated real-time display incorporates most of the important functions available to the operator of an IR dynamic display. It provides a moving-window display, a frame-hold mode, field-of-view control, and a 6-digit Universal Test Message read-out.

Simulation was accomplished through a TV camera scanning the infrared stimulus imagery, moving across a light table, and presenting the image on a video monitor. Film movement rate was controlled by the light table with motorized drive and infinitely variable film speed control. Image movement was from top to bottom of the CRT. The monitor had a capability of about 800 scan lines.

Constancy of stimulus presentation was controlled by the experimenter at his master console to present the problem situations in accordance with the systems measurement bed scenarios. Associated with the simulator were devices to record examinee responses.

A microphone connected to a tape recorder was attached around the examinee's neck and he was given a response-pointer with a micro-switch at the end which, when activated, triggered a camera focused on the display surface. His job: Detect and identify targets as specified by particular missions.

The research data of this systems measurement bed experimentation provided human factors answers needed by systems designers and users for future surveillance systems of this family.

The Alpha-Dot System. This is another example to show how automatic data processing and transmission, to be helpful to commanders on the battlefield, must be accomplished with great rapidity. At present, available means of acquiring such data need improvement in flexibility of equipment, broader message capabilities, and reduction of demands made upon operators.

ARI scientists in the Systems Integration and Command/Control Technical Area seek a solution to this problem, predominantly in the behavioral dimension of the man/machine system. There are two basic ways in which men encode information—serial and parallel. ARI behavioral research has shown that performance is less than optimum if the limits of either modality are exceeded. This notion has led to a new approach to data entry—the Alpha-dot system.

Providing a bridge between man and machine, the Alpha-dot system allows the operator to input data using characters that have a familiar shape yet are encoded in computer-compatible binary form.

In addition to all letters and numbers, this system permits convenient entry of mathematical and other symbols as well as machine functions such as carriage return, line advance, and backspace. It can be the basis for a number of small, low-cost, mechanically simple data entry devices.

Experimentation with one such device, a 5-finger keyboard built by ARI, permitted data entry capability comparable to typewriter entry for certain battlefield messages. Several other new forms of message entry and display devices for improved 2-way battlefield communication are under experimental development.

In addition to their military uses, devices based on the Alpha-dot principle have a potential fallout as an aid for various handicapped persons. The communication capability of the blind, deaf and persons with only one hand may be greatly impoved with such devices.

RATAC. ARI research scientists of the field experimentation unit at Fort Hood (another element of ARI reporting to the OSRL director) are assisting in evaluating and recommending improvement in complex surveillance systems, including RATAC, designed as a replacement for the current TPS-25 ground surveillance radar.

The RATAC is a lightweight doppler system to detect moving targets and to facilitate adjustment of ground artillery fire. The research objective was to determine the RATAC's capabilities in typical operational field conditions and what improvements might be necessary.

ARI research scientists found that existing training was insufficient, since operator efficiency increased during the test. Operators became most fatigued and made the most errors during times of least enemy activity on the scope. Times of greatest enemy activity on the scope—when operators had to make most use of their senses and muscular capabilities—were the least fatiguing.

Through experimentation, it was determined that a shorter workday would not *improve operator effectiveness. Under combat conditions, a 12-hour workday appeared advantageous and reasonable.*

Fatigue problems caused by operator/equipment interface were noted. Approximately two-thirds of the operators reported eye discomfort and one-fourth developed headaches. One in eight developed earaches attributed to shrillness of the audio signal and the noise of the generator and air conditioner.

"Try before buy." All RATAC operators experienced specific difficulties making adjustments to the power supply, whereas none experienced problems in making adjustments on either the console or the antenna.

The problem with the power supply was not one that could be solved by increased or specialized operator training, or by selecting operators with special capabilities. The problem could be alleviated only by redesign of the housing pallet.

Based on these and other findings, Project MASSTER (Modern Army Selected Systems, Test, Evaluation and Review) recommended changes in systems doctrine and equipment design.

Team Performance Enhancement. The ARI field experimentation unit at Ford Ord, Calif., strives to improve performance of groups in a variety of military systems in a research program responsive to CDC and CONARC requirements for human performance data. Results are directed toward maximizing the quality of human performance in the use of field and combat equipment. They have wide application to selection, training, work methods, and task organization.

A series of experiments tested the performance of soldiers using different passive night-vision devices. Instrumentation developed by ARI personnel provided an immediate objective record of performance by which the merits of the several devices for different activities could be gauged.

Products of the experimentation enabled CDC to recommend the number of Starlight Scopes to be issued to a squad, and work methods to be employed.

ARI's Team Performance Enhancement Technical Area includes a research program in aircrew performance.

Behavioral strains imposed on helicopter crews have significantly increased because of mid-intensity warfare requirements. To avoid detection by sophisticated ground missiles, the pilot is forced to fly at nap-of-the-earth (NOE) altitudes, increasing pilot stress and error potential. Terrain obstructions, such as transmission lines, create almost invisible barriers which must be detected and avoided —problems compounded at night.

Plans are under way to reduce pilot stress through development of a more effective training program within units. ARI's experimental test bed will make it possible to simulate the pilot's NOE visual experiences and to study in fine detail the visual cues needed for this type of flight.

Unit Training. The Unit Training and Edu-

(Continued on page 26)

A R I—a new name, a new approach

(Continued from page 25)

cational Technology Systems Technical Area executes research to increase unit training skills, maintain proficiency, and develop human factors methodologies in educational technology systems.

The initial goal is to provide commanders with improved means of discharging their training responsibilities through handbooks providing information on easily implemented training techniques and procedures, and new curricula for enhancing capability of unit trainers.

Of longer range benefit to the Army training community are projects to provide methods of revising and updating training literature and methodology for predicting effectiveness of training devices.

Individual Training and Performance Research Laboratory. The ITPRL has a 4-fold mission executed in three technical areas and by a field unit which will soon be activated at Fort Benning. The technical areas are:

· Improving the training of enlisted, noncommissioned and officer personnel, and improving manpower procurement, distribution and retention procedures.

· Enhancing individual soldier and officer leadership skills and capabilities.

· Increasing the Army's capability to help the individual soldier resolve unique personal problems and to adapt to social change.

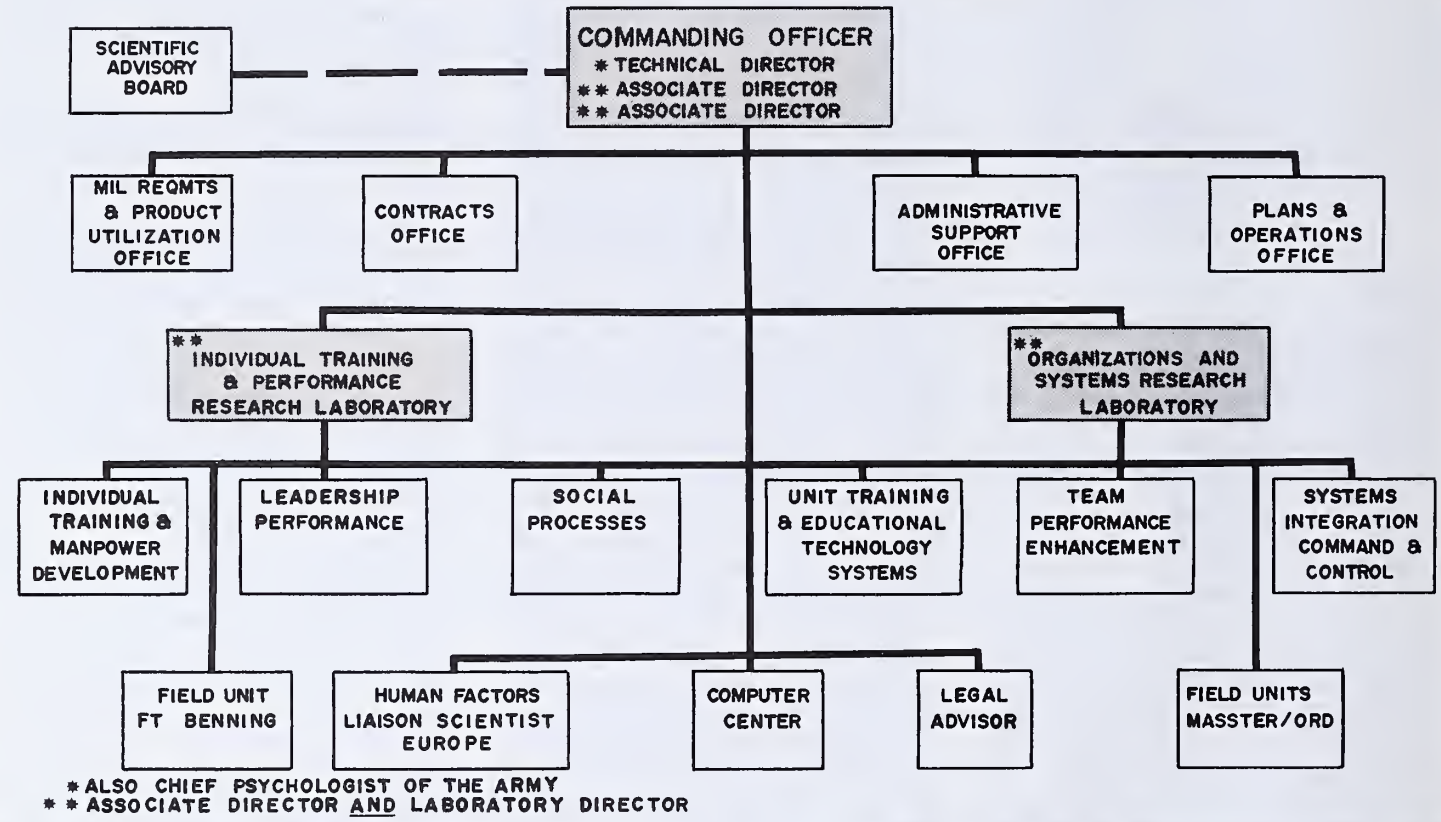
Scientists in the Individual Training and Manpower Development Technical Area will find that their mission to develop, train and improve enlisted manpower can now be treated in a system interface.

More emphasis will focus upon how to assist the soldier in realizing his full potential as a careerist. The research stresses application of all modern techniques, including computer techniques, in the attempt to strengthen officer and enlisted career management systems.

Research programs are likewise planned to improve the career development of minority members of the U.S. Army. An effort will be made to facilitate research to explore tradeoffs between aptitude levels and differential instructional strategies, to the advantage of future personnel efficiency and career intentions.

Leadership Performance Technical Area. ARI research on leadership performance is shaped to meet evolving concepts of the Army's mission and the changing requirements imposed on Army leadership—including

U.S. Army Research Institute For the Behavioral and Social Sciences



COL R. A. Rooth

Dr. J. E. Uhlaner

Dr. E. Ralph Dusek

Dr. Joseph Zeidner

those given expression in officer personnel management systems.

Additionally, leadership trraining has been systems-engineered to insure that program objectives are optimally oriented toward actual duty performance required of the Officer Candidate School (OCS) graduate.

Previous research has identified two main dimensions of behavior across a number of situations requiring leader response, including combat leadership and technical managerial leadership.

Combat leadership requires a more directive style, characterized by decisiveness, bearing and assurance, clear and forceful communication. Technical/managerial leadership requires a grasp of mission requirements and response to data inputs from the field.

These two research-based factors relate clearly to lines of differentiation delineated in officer career development planning. Application of findings and techniques from this research goes beyond selection to ongoing evaluation for use both by officer personnel management and the individual officer.

Evaluation in realistic simulations is one major application of the technological base previously developed. An Assessment Center is being established at the Infantry School, Fort Benning, Ga., to assist in the leadership development of officers and NCO leaders and in final selection of OCS candidates.

In this center (and other projected centers), situations typical of the leadership activity required of an Army officer are simulated "Live." Groups of candidates go through the standardized exercises, and are evaluated by specially trained assessors on their potential and areas of weakness. The evaluations are used as a basis for selection and promotion, or may be fed back to the individual as guidance for his leadership development.

Social Processes Technical Area. In the IPTRL, in the Social Processes Technical Area of the Individual Performance, a new research effort seeks to increase the individual soldier's capability to resolve problems associated with morale and discipline—racial disharmony, social change, career planning (EM and officers), socialization and adjustment of the soldier to the Army, prevention of drug and alcohol abuse, and soldier-family-community relationships.

As an example, research dealing with racial disharmony has already accomplished two major tasks—development of a handbook, *Guidelines for Leaders*, designed for use of Army unit leaders who cope with racial problems on a day-to-day basis, and the development of a state-of-the-art report on the Army's race relations program. The report provides a comprehensive reference source for Army personnel working on problems of race relations in the military.

Draft editions of these documents were completed in the summer of 1972. HQ U.S. Army Europe (USAREUR), after participating in the evaluation of the guidelines, requested permission to reproduce 1,200 pre-publication copies, which have been distributed to all units in Europe.

The final edition of the guidelines will be published as a Department of the Army document in the near future. Similarly, the final edition of the state-of-the-art report will be published in the spring of 1973.

Additionally, a field survey of the Army's race relations program has been made through interviews and administration of questionnaires at installations in the Continental U.S. Armies, USAREUR and Korea. The survey measured, among other items, the attitudes and perceptions of 3,900 enlisted men and women and 240 officers. An important outcome is baseline information on the current program.

The race relations research program is currently planning to validate a Racial Perceptions Inventory developed at Walter Reed Army Institute for Research at the request of the Department of Defense. This instrument will be validated across all services worldwide.

Military Requirements and Product Utilization. Assisting in the coupling between the ARI customer and the scientist in the technological areas is the Military Requirements and Product Utilization Office. This newly formed group will help customers at both ends of the research product—they will be available to assist in defining problems, and to adapt research products to operational use.

Military officers who comprise this group are qualified in their basic branches, and also have advanced degrees in the behavioral and social sciences. One of the officers in the group is the chief of the ARI Korean unit.

Anticipated New Benefits of ARI. In general, ARI provides the Army a more clearly defined over-all behavioral and social science program that is responsive to sponsor requirements.

The program is designed for an adequate technological base from which to progress logically and in timely fashion to needed applications. It is problem- and product-oriented, with a unified but flexible and adaptive staff, ready to interface with commands and agencies on a worldwide basis.

COL Richard A. Rooth, formerly director of MANRRDC, is charged with over-all management of ARI. He holds a master's degree in anthropology from the University of Minnesota and his 25 years of military experience includes assignments as a battery and battalion commander.

Dr. J. E. Uhlaner, ARI technical director, has had a 25-year association with Army behavioral and social science R&D, including serving as director of the Behavioral and Social Science Research Laboratory (BESRL) since 1961. He has received the Meritorious Civilian Service Award and the Exceptional Civilian Service Award. A former president of the Division of Military Psychology of the American Psychological Association, he is a member of the American Psychological Association Council of Representatives.

Dr. Joseph Zeidner, an associate director at ARI, is director of the Organizations and Systems Research Laboratory. Dr. Zeidner was deputy director for Manned Systems Research in BESRL and chief of the Support Systems Research Division. He first joined BESRL in 1950 (then the U.S. Army Personnel Research Section of TAGO) and has served continuously except for the period June 1968 to August 1969, when he was a liaison scientist in the Office of Naval Research, London, England. He holds a master's degree from Fordham University, and a PhD from Catholic University of America. In 1971 he received the Meritorious Civilian Service Award.

Dr. E. Ralph Dusek, an ARI associate director, also heads the Individual Training and Performance Research Laboratory. He joined BESRL in August 1971 after 18 years in the Army Research Institute of Environmental Medicine and the Army Natick (Mass.) Laboratories. He has a master's degree and a PhD degree from the State University of Iowa and is a graduate of the Industrial College of the Armed Forces.

Other key people in the ARI organization are: technical area chief (TAC), Individual Training and Manpower Development, Edmund F. Fuchs; TAC, Leadership Performance, Dr. William H. Helme; TAC, Social Processes, to be designated; TAC, Unit Training and Educational Technology Systems, Dr. Frank J. Harris; TAC, Team Performance Enhancement, Dr. Aaron Hyman; and TAC, Systems Integration and Command/Control, Cecil D. Johnson.

Field unit chiefs are Jack J. Sternberg at Fort Ord, George M. Givideen at Fort Hood, and at Fort Benning (to be designated).

Dr. Arthur Drucker is chief of the Plans and Operators Office, Dr. John J. Mellinger heads the Computer Center, Frederick S. Jones is chief of the Contracts Office, Joseph F. Howard is the legal adviser, and CPT Ralph W. James is adjutant.

HumRRO Studies Human Vision At Night Combat Operations

What are the human factors limitations of operators of U.S. Army night-vision devices in a combat environment? How can differences in capabilities of operators be identified? How can the findings be applied to increase training methods effectiveness?

These are some of the questions that are addressed in Work Unit NIGHTSIGHTS by the Human Resources Research Organization (HumRRO), Division No. 2 at Fort Knox, Ky. Some of the results are detailed in HumRRO Technical Report 72-30: *Effects of Information Load, Location, and Mode of Observation on Identifying Brief Targets,* authored by work unit leader Dr. Harold B. Bishop.

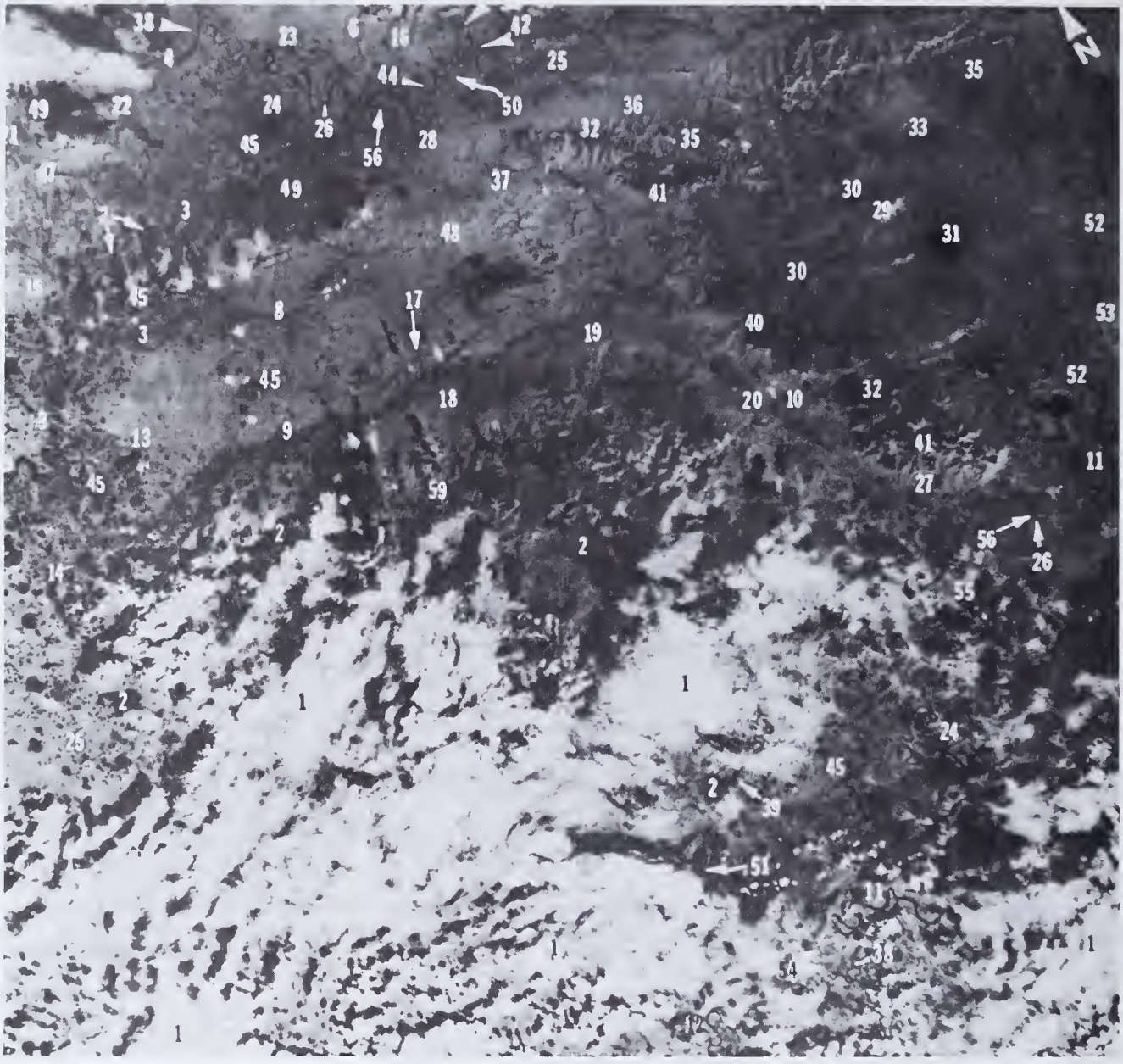
Directed primarily to ascertaining the limitations of human vision in identifying dimly lit figures in a combat environment, the NIGHTSIGHTS study is expected to yield findings of considerable potential for applications to many civilian requirements—such as those of traffic safety engineers, airplane pilots, law enforcement officers, etc.

Dr. Bishop discovered that 0.17 second is a critical threshold below which a subject's ability to identify or even perceive an object rapidly deteriorates. The report contains numerous graphs plotting milliseconds of observation against relative brightness for various types of targets.

Subjects were asked to identify a geometric figure out of either a set of two or a set of eight as image brightness was controlled by passing light through two polarizing filters. Half of the subjects were not told where in the field of vision the image would appear.

The primary purpose of the study was to find an optimum method of training users of night-vision devices. Among the conclusions are that it is probably not possible to train an observer to identify objects quicker than 0.17 seconds, but that the observer's range of attention and ability to identify targets both could be improved.

Copies of Technical Report 72-30 can be obtained from HumRRO at 300 North Washington Street, Alexandria, Va. 22314.



ERTS-1 imagery of 115-mile-square area 250 miles N.W. of Fairbanks, Alaska.

1. Clouds
2. Cloud shadows
3. Kugarak River
4. Kobuk River
5. Ambler River
6. Shungnak River
7. Selby River
8. Rabbitt River
9. Selawik River
10. Dakli River
11. Koyukuk River
12. Kateel River
13. Kawichiark River
14. Tagagawik River
15. Kuchuk Creek
16. Cosmos Creek
17. Kiliovilik Creek
18. Shinilikrok Creek
19. Shiniliaok Creek
20. Wheeler Creek
21. East side of Great Kobuk Sand Dunes
22. Little Kobuk Sand Dunes
23. Pitkik Lake (Oxbow Lake)
24. Meander scars
25. Lakes and ponds
26. Sand bars
27. Solsmunket Lake
28. Tekeaksakrak Lake
29. Forest fire smoke
30. Smoke shadows
31. Recently burnt areas
32. Drainage patterns (stream erosion valleys)
33. Pah River Flats
34. Norutak Hills
35. Lockwood Hills
36. Mountain slope vegetation
37. Pick River
38. Cleared areas (cabins with clearings)
39. Birch Lakes
40. Zane Hills
41. Bedrock outcrops or valley shadows
42. Kobuk village
43. Dahl Creek Airstrip
44. Shungnak Village
45. Swampy, flatland
46. Jade Mountains
47. Waring Mountains
48. Sheklukshuk Range
49. Old burned area
50. Shungnak Airstrip
51. Nogahabara Sand Dunes
52. Hogatza River
53. Babantaltlin Hills
54. Three-Day Slough
55. Cutoff Slough
56. Mid-Channel Islands
57. Mauneluk River
58. Kogoluktuk River
59. Purcell Mountain

ERTS-1 IMAGERY . . .

Arctic and Subarctic Environmental Analysis

By Dr. Duwayne Anderson, Richard Haugen, Lawrence W. Gatto, Dr. C. W. Slaughter, Dr. Harlan McKim and Thomas Marlar

Wise utilization of the earth's resources is now acknowledged to be a primary concern of our society. Problems of resource utilization have been dramatized in Alaska, where a severe lack of basic environmental data and understanding has collided with rapidly mounting pressures for extensive development of industries, transportation systems and population centers.

Existing information on Alaska's water cover and distribution, properties, and behavior of permafrost terrain is insufficient for an understanding of its various environments and their interrelationships.

The history of construction and technological development in Alaska dramatically illustrates the difficulties caused by environmental extremes; it also shows the possibility of serious unforeseen consequences of disturbing established environmental balances.

Scientists at the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, N.H., are studying the arctic and subarctic environments of Alaska, using the information from the NASA Earth Resources Technology Satellite, ERTS-1, launched July 23, 1972.

(For a detailed explanation of the over-all scope of ERTS-1, see lead feature article beginning on page 38 of the August 1972 edition of the *Army R&D Newsmagazine*.)

Since its inception in 1961, CRREL has continued an active role in basic and applied research and engineering in cold regions. A major objective of the ERTS study is the development of practical knowledge that permits man to live in greater harmony with the cold regions environment, and to identify and utilize its existing resources in the most favorable manner.

In the ERTS-1 program, the CRREL will study a number of aspects of the Alaskan environment. The relationship of snow pack and river icing hydrology is one of the more important areas of investigation. A comparison of the major tonal and textural permafrost geomorphic patterns on ERTS imagery will be made with that of Mariners 6, 7, and 9 to present a plausible interpretation of the various terrain patterns of Mars.

ERTS-1 imagery will be used in another major effort to study surface circulation and coastal sedimentation processes in Cook Inlet, Alaska, which leads to Anchorage harbor. The information derived will be applied to the maintenance and improvement of navigable waters, harbor construction and siltation problems.

ERTS imagery will be used in a third area of primary concern to evaluate permafrost-vegetative relationships, permafrost distribution, its seasonal thaw regime and environmental relationships in interior Alaska. Permafrost is a major environmental and engineering factor in Alaska and other high-latitude regions.

This perennially frozen ground is a result of complex interaction among such environmental factors as local microclimate, the insulating qualities of organic and vegetative cover, and the texture and moisture content of soils. In central Alaska, the distribution of permafrost is discontinuous because the present climate in this area is near the threshold values for the continued existence of permafrost.

Only in well-protected locations, such as north-facing slopes, shaded valley bottoms and high elevations within the region does permafrost exist. Minor changes in thermal regime, whether natural or man-induced, can produce major alterations in permafrost landscapes.

In all of these studies, interpretation of the ERTS imagery will be accomplished through comparison with photographs of selected areas taken by low-flying aircraft and by actual ground-level observations.

ERTS-1 utilizes multispectral scanner and return vidicon cameras that record information in seven spectral bands. The data is returned to the three main ERTS tracking stations: Fairbanks, Goldstone and Goddard.

One of the initial scenes of Alaska, acquired during orbit 44 on July 26, is shown in Figure 1. The image is a composite made from data acquired in the green, red and an infrared band of the multispectral scanner.

Shown is a 115-mile square located 240 miles northwest of Fairbanks that includes Kobuk and Shungnak villages. The resolution varies with the gross shape and tone contrast of a feature. Rounded features (i.e. streams) to 150 feet wide are visible. The resolution of this composite and the individual bands is considerably better than anticipated prior to launch.

Registration accuracy of the color printing process causes features that are distinct on single-band photos to become somewhat blurred on composites, but the resolution is still remarkably good and a thorough interpretation of the regional features can be made. Clouds (1) cover a large portion of the lower half of the photograph. Cumulus clouds at approximately 8,500 feet altitude cap the higher peaks of this area while cirrus clouds occur at a higher level. Cloud shadows (2), reflecting the cloud shapes rather well, may be confused with the ponds and lakes (25) of this area.

The areas burned by forest fires are very prominent features. At the time this photograph was taken a forest fire was burning in the Pah River flats (33) area. By July 26, 1972, this fire had burned 81,000 acres. The smoke (29) and smoke shadows (30) are readily apparent. The recently burned areas (31) appear black while old burned areas (49) show some evidence of revegetation.

Evidence of a variety of human activity in this area is visible. Two bush airstrips can be seen, the Shungnak airstrip (50), and the Dahl Creek airstrip (43). Both are located near small villages along the Kobuk River, Shungnak village (44) and Kobuk village (42), respectively. A number of cleared areas (38) were located. These may be homestead sites and the presence of cabins was verified with underflight photography.

Kugarak River (3) and its tributaries, Kawichiark River (13), Kuchuk Creek (15), and Rabbitt River (8) are well-defined by the contrast between the vegetation bordering the streams and the surrounding vegetation. They drain a significant portion of the photographed area, including the Waring Mountains (47), the Sheklukshuk Range (48), and the swampy flatlands bordering the Waring Mountains on the south and east and the Sheklukshuk Range on the north, west and southwest.

The Kobuk River (4), one of the major rivers shown, flows westerly into the Hotham Inlet of Kotzebue Sound, about 80 miles west of the photo area. Along the stream course, meanders are abundant and meander scars (24) and oxbow lakes, such as Pitkik Lake (23), mark channel positions of a former time.

Erosion along the river is evidenced by the deposition of sands and gravel on the inside of meanders. These deposits in some places occur as sand bars (26), point bar deposits, which appear as lighter areas along the stream course, and as mid-channel islands (56) in braided streams.

Some of the more obvious rivers and streams tributary to the Kobuk River are: Ambler River (5), Shungnak River

(Continued on page 30)

Arctic and Subarctic Environmental Analysis

(Continued from page 29)

(6), Cosmos Creek (16), Koguluktuk River (58), Mauneluk River (57), Pick River (37) and the Selby River (7). The banks of these are outlined by distinct vegetation patterns along the stream course. Trees are more abundant and dense along the streams' banks but scattered in the bordering lowland areas.

Dendritic drainage patterns are obvious throughout the photo, but the best example is present on the south and east slopes of the Waring Mountains (47). Here the alternating dark and light vegetation patterns respectively reflect the stream and inter-stream areas.

Another major river, the Selawik (9), flows in a westerly direction to Selawik Lake, an embayment of Kotzebue Sound, not shown on the photo. This river has numerous meanders and drains the western portion of the Zane Hills (40), the mountainous region around Purcell Mountain (59), and the swampy flatland are (45) in the photo.

Some of the tributaries of the Selawik are defined by the dark vegetative patterns along the stream courses: Tagagawik River (14), Kiliovilik Creek (17), Shinilikrok (18), and Shiniliaok Creek (19). The area around the Kugarak-Selawik River junction is swampy flatland with numerous lakes and ponds.

Dakli River (10) and its tributary Wheeler Creek (20), which are defined by the distinct vegetative patterns along these streams, are 4th- and 3rd-order streams, respectively, according to the Strahler-modified Horton classification. These streams drain the southwestern portion of the Zane Hills (40), and the northeast portion of the mountainous area around Purcell Mountain. At the southern portion of the Dakli River, near its junction with the Koyukuk River (11), the surrounding area is swampy, with many ponds and lakes.

The Koyukuk River (11) shows extensive meandering and has numerous meander scars and sloughs along its course. Three-Day Slough (54) and Cutoff Slough (55) are two examples. The Koyukuk and its tributaries (e.g. Kateel River) (12) drain most of the area in the lower right quarter of the photo. It flows over very flat, swampy land characteristic of a geomorphically old-age area.

The Babantaltlin Hills (53) and the meandering Hogatza River (52) are located Southeast of the Pah River flats fire. The area is extensively forested, with many lakes. Along the Hogatza River are numerous point bar deposits.

The Lockwood Hills (35), Zane Hills (40), Jade Mountains (46), and the Norutak Hills (34) show extensive bedrock exposures (41) on the peaks and crest lines. These appear as dark areas outlined by lighter vegetation. Extensive stream erosion valleys (32) with dendritic drainage patterns are visible on the mountains.

Vegetation tones in the photo are attributable to the type of surface material, climatic parameters and slope. Mountain slope forests (36) are visible in the hilly areas, while the bog vegetation in the swampy areas is a lighter shade and also quite distinctive. The dark vegetation tones following stream valleys are very useful in tracing the river courses on the photo.

The numerous lakes and ponds on the photo are varied in size and shape. Tekeaksakrak Lake (28), nearly two miles long, and Solsmunket Lake (27), slightly larger than two miles, are two of the larger lakes on the photo. They are similar in shape with an elongate N-S axis. Birch Lakes (39) is one mile across with a circular shape. The multitude of lakes and ponds indicates poor drainage in the lowlands and a proximity to base level.

Wind deposition was active during the Pleistocene in the photo area. Sites of sand deposition are apparent as irregular-shaped, light-colored areas; the Little Kobuk Sand Dunes (22), the east side of the Great Kobuk Sand Dunes (21), and (somewhat hidden by clouds) the Nogahabara Sand Dunes (51) southwest of Birch Lakes. These deposits result from wind erosion across extensive periglacial outwash plains, with subsequent deposition in areas where the wind-borne materials are retained.

In view of the lack of environmental information in arctic and subarctic areas, the advantages of surveys by polar-orbiting satellites are obvious. Until now, obtaining environmental data in polar regions has been very difficult and the launching of the ERTS satellite comes at a most opportune time.

Scientists at CRREL look forward to an immediate yield of information vital to a more rational, safe and productive program of development of arctic and subarctic areas, by methods that will have a minimal impact on the environments found in Alaska.

32 Societies Contribute to Environmental List

Cooperative efforts of 32 professional societies are incorporated in a new *Directory of Environmental Scientists in Agriculture,* published by the Council for Agricultural Science and Technology.

The stated purpose of the directory is to provide "ready access to authoritative sources of factional information on environmental matters relating to agriculture." The scientists listed, with addresses and telephone numbers, are contributing their time and talents to the directory project as a public service.

Scientists are listed alphabetically, in their areas of specialty and by states in which they reside or are currently employed. Provided also is a list of directors, secretaries and commissioners of state departments of agriculture who are termed "an especially good source of information on regulations and agricultural statistics."

Dr. Carl Lamanna, for more than a decade the deputy chief of the Life Sciences Division, Directorate of Army Research, Office of the Chief of Research and Development, HQ Department of the Army, is the only U.S. Army scientist included in the directory.

Cooperating societies listed are the American Academy of Clinical Toxicology, American Agricultural Economics Association, American Association of Cereal Chemists, American College of Veterinary Toxicologists, American Dairy Science Association, American Forage and Grassland Council.

Also, the American Meat Science Association, American Medical Association, American Meteorological Society, American Phytopathological Society, American Society for Horticultural Science, American Society for Microbiology, American Society of Agricultural Engineers, American Society of Agronomy, American Society of Animal Science, American Society of Landscape Architects, American Society of Sugar Beet Technologists, American Veterinary Medical Association, American Nutrition Research Council.

Also, the Association of Official Analytical Chemists, Association of Official Seed Analysts, Crop Science Society of America, Entomological Society of America, Institute of Food Technologists, Phytochemical Society of North America, Potato Association of America, Poultry Science Association, Society for Range Management, Society of American Foresters, Society of Nematologists, Soil Society of America and the Weed Science Society of America.

The address of the publisher, The Council for Agricultural Science and Technology, is 677 South Segoe Road, Madison, Wisc. 53711.

TACOM Employes Earn CG Praise For Discoveries Leading to Patents

Patent grants for disclosure of inventions by five employes of the U.S. Army Tank-Automotive Command (TACOM), Warren, Mich., recently earned MG Joseph E. Pieklik's praise as TACOM commanding general.

Gregory Arutunian and David Wilburn, who together patented a fluid flow meter, are Propulsion Systems Division employes. Harry Spiro of the Vehicular Components and Materials Division and Stanley M. Keithley of Aberdeen (Md.) Proving Ground received a joint patent for a bar armor system.

William Kenneth Scott, Propulsion Systems Division, received a patent for developing a method to detect and classify defects in internal combustion engines. Dr. Jack G. Parks was cited for inventing a ferrofluid ultrasonic signal modulator.

Deputy Assistant Commissioner of Patents William Feldman made an hour-long speech, as a feature of the awards ceremony, on the three types of patent systems in use.

Hide from the Enemy . . .

MERDC Leads Major Effort in Camouflage Technology

By E. O. Davis

Hide from the enemy!

That about sums up the objective of camouflage, but it is not a simple task. Recent advances in remote sensing systems and information processing have made it necessary to counter those surveillance means—to reduce the vulnerability of targets and complexes.

For many years, little emphasis was placed on camouflage, but now a major effort is under way at the U.S. Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va. The U.S. Army Materiel Command designated the center in April 1972 as the lead laboratory for camouflage technology.

In this context, camouflage technology (CT) has been defined as that required to minimize the probability of detection, identification and location of personnel, structures, material, and terrain features, including spoor, through passive means of hiding, blending, disguise and simulation.

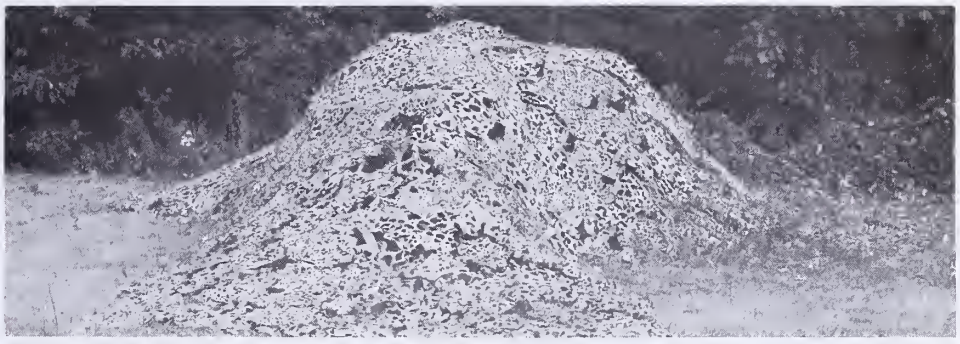
The MERDC effort includes camouflage against all militarily significant approaches to remote sensing—particularly the electromagnetic spectrum from ultraviolet through radar wavelengths. Active measures intended to jam, interfere, or otherwise render ineffective the remote sensing means, or its transport, are excluded from this definition.

In its role as lead laboratory for CT, the MERDC has instituted a vigorous effort to assess and reduce the vulnerability of AMC systems by building camouflage features into equipment design. This includes measures on existing equipment, where practicable, but is aimed mainly at the long-term development items. A concerted, MERDC-funded, AMC-wide start on this camouflage effort was initiated last May.

A countersurveillance analytical tool for categorizing targets, as a function of signature, was developed under contract with Stanford Research Institute. This computer model, which predicts the vulnerability of targets and the effectiveness of camouflage treatments relative to the various sensor threats, is being exercised and refined in-house on a CDC 6600 computer. Subroutines are being added to determine the effect of terrain massing, to perform cost-effectiveness evaluations, and to provide a graphical read-out capability.

Two computer programs have been developed in-house to aid in design of camouflage material. One, the Photomatch program, is being tested to predict the response of camouflage colorants to spectrozonal photography, which will minimize the need for field evaluation of development materials.

The program, termed Colormatch, will enable computerized formulation of camouflage colorants to meet any desired spectral characteristics. Thus, it will eliminate the inefficient "cut and try" process formerly required in color development. Preliminary results, using a base of 18 pigments, have been verified for blends in the visible spectrum. The program is being expanded to a base of several hundred pigments, and to cover the near infrared spectrum as well as special camouflage spectral characteristics.



CAMOUFLAGE NET developed by MERDC to provide a quick means of concealing equipment from visual, radar, photographic and near infrared detection, consists of 900 square feet of hexagonal modules designed to approximate the symmetry typical of natural objects. A diamond-shaped screen is provided to maintain symmetry when two or more modules are joined. The net comes in color combinations for use in woodland, desert and snow areas. It is reversible to provide concealment during seasonal changes.

The MERDC is participating in a joint NATO program to assess the vulnerability to detection and identification of military equipment, and to measure effectiveness of camouflage treatments. The effectiveness of progress levels of camouflage will be evaluated as a function of cost and effort. The plan is being coordinated with NATO countries for implementation during FY 73.

An experimental far infrared camouflage system for concealing heat-producing targets, such as generator sets, has been demonstrated successfully. It is a modular system that will incorporate visual and radar camouflage characteristics to provide a broad spectrum concealment.

The Macroscope, a compact, indoor radar test range, began experimental operation in 1972. With use of 1/10-scale models of targets, the frequency is scaled to simulate operational radar sensors. This provides a detailed target signature analytical capability and minimizes expensive, time-consuming field measurements. Measures for signature suppression were studied to provide input to prototype developments by other AMC laboratories.

A model of a foam simulator also was developed and demonstrated successfully. The concept is a compressible foam, which can be rapidly molded to the configuration of the archetype target item and vacuum packaged to less than 1/10 original bulk for storage and transport. The item recovers original bulk and configuration when unpackaged.

The U.S. Army Land Warfare Laboratory (LWL), Aberdeen (Md.) Proving Ground, conducted experiments for the R&D Center, on ground mobilization of helicopters for camouflage siting. The LWL also made progress on reduction of glare from helicopter cockpit canopies and rotor blades.

To bring into sharper focus the camouflage problem of the field army, a demonstration of the state-of-the-art camouflage capability was conducted at MASSTER (Mobile Army Sensor System, Test, Evaluation and Review), Fort Hood, Tex., during the ACCBII/TRICAP I exercises in February 1972.

As a result, MASSTER exercises are being planned for troop indoctrination on camouflage practices, and for devising, testing and evaluating new camouflage techniques and material. The center has established a team on-site to provide a continuing quick-reaction capability to meet new camouflage needs as they are identified in the exercise.

Development of a complete camouflage system was initiated for the Hawk missile system that will be rapidly deployable and compatible with operations.

A new camouflage screening system will replace the obsolescent burlap-garnished, cotton-twine netting. Components include a basic hexagonal net covering 900 square feet and a diamond-shaped filler net to maintain symmetry when two or more hexagonal nets are joined.

Fabricated of polyester garnished with polyvinyl chloride-coated spun-bonded nylon, each system is being equipped with quick connect-disconnect devices to permit rapid emplacement and removal. Two basic and filler nets can be joined in five minutes, with additions in less time.

One module, including basic and a filler net and a repair kit, weighs 50 pounds with carrying case. It is designed to provide concealment from visual, radar, photographic, and near-infrared detection. The screening system will be provided in color combinations for use in woodland, desert and snow areas. It is reversible to adjust to seasonal and color differences existing in nature.

In addition to easier and more rapid handling than the large assortment of sizes, shapes and color blends found in the current standard burlap-garnished cotton nets, the new system offers advantages in durability and resistance to water and oil absorption.

The woodland blend completed engineer test at Fort Huachuca in March and is in service test in Panama. A contract was awarded in 1972 to develop processes for quantity production of this new system.

Employed since 1953 at the U.S. Army Mobility Equipment R&D Center, E. O. Davis attended Bethany (W. Va.) College, and in 1935 started his journalism career as a feature story writer and general news reporter for daily newspapers in Western Pennsylvania and West Virginia, later serving as editor of two weekly newspapers. Since 1956, he has been employed in the MERDC Information Office and its predecessor organizations.

USMA Stresses Design Process in Weapons Engineering

By MAJ John F. Geiger

"Weapon Systems Engineering," a 2-semester course offered to seniors at the United States Military Academy (USMA), West Point, N.Y., is one of the most unusual college engineering courses taught today.

One fundamental reason for this difference is that, unlike conventional engineering institutions, the USMA does not train engineers in the conventional sense. The basic mission of the Military Academy is to train cadets for a lifetime career as officers in the Regular Army. Therefore, "Weapon Systems Engineering" is structured for officers, not professional engineers.

The question to be answered is, "What should a Regular Army officer know about engineering?" The Department of Engineering, headed by COL Charles H. Schilling, offers one answer.

The career Army officer should be thoroughly familiar with the design process—the methodology which the designer uses regardless of the object designed. By stressing this "morphology of design," the cadet is better able to appreciate requirements for good materiel, whether the object of interest is a bridge, a gun tube, or a complex self-propelled weapon system. It is this knowledge of the design process, not knowledge of specific hardware, which is considered essential to a military career.

The hardware, as a "nonessential," is left to the interest of the cadet. Each cadet is free to select one or two of the following standard engineering courses: electrical engineering, nuclear engineering, civil engineering, general engineering, or weapon systems engineering. The cadet may also supplement this choice with engineering or other elective courses based on his interest.

Another reason for the unusual nature of "Weapon Systems Engineering" is obvious from the title itself. The subject is rarely taught. Aside from the current unpopularity of things military, one reason for the rarity of this subject is the breadth and depth of subject matter. How does one teach the design of weapon systems, given the complexity and diversity of modern weapons today? The remainder of this article describes how "Weapon Systems Engineering" attempts this task.

In general, the course is structured as a series of related subcourses (see course chart). After receiving instruction on design theory, cadets concentrate on the design of major weapon system components. They actually perform preliminary design of such components as a gun tube, a recoil system throttling rod, a rocket nozzle, a vehicle gear train, or a servomechanism amplifier.

The final subcourse of the series is a realistic analysis exercise in which cadets apply knowledge gained over the year to determine which of several proposed weapon systems the Army should buy.

Thus the general approach to teach design of weapon systems is to teach the methodology quickly, while emphasizing the application of that methodology in realistic design exercises. Reality is further enhanced through a program of guest lecturers and laboratories interspersed throughout the year.

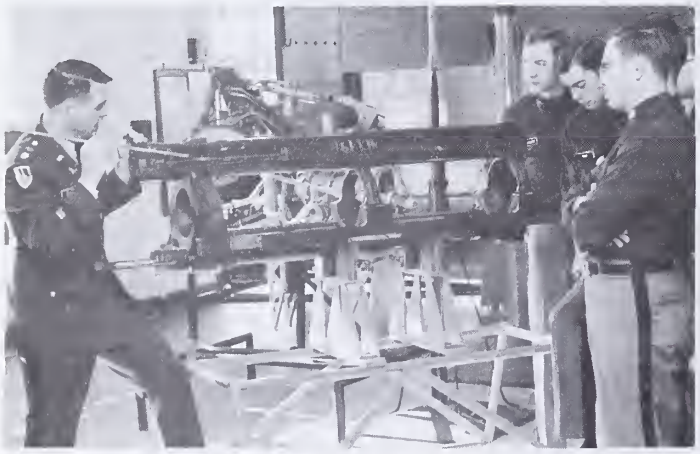
The first subcourse, Fundamentals of Design, teaches the cadet the formal design process. In this block, the cadet is able to relate the design task with his new career as a military decision-maker.

TABLE 1
Weapons Systems Engineering (1971–1972)

First Semester				
Fundamentals of Design (16 lessons)	Gun Tube Design (13 lessons)	Recoil System Design (6 lessons)	Control System Design (7 lessons	Terminal Effects (4 lessons)
Second Semester				
Design for Flight (5 lessons)	Rocket Design (15 lessons)	Design of Land Vehicles (19 lessons)	Weapon System Design Study (8 lessons)	

MAJ John F. Geiger was born in Brunswick, Ga., in 1937. He graduated from the U.S. Military Academy in 1960 and received a master of science degree in mechanical engineering from the University of Southern California in 1969.

MAJ Geiger has served with the 3d Infantry Division, Germany, as an Infantry officer and as an Ordnance Maintenance Company commander. He has worked on the staffs of the Ordnance Guided Missile School, Redstone, Ala., and the 53d General Support Group, Vietnam. MAJ Geiger is serving a second tour of duty in Vietnam following an assignment as course director for "Weapon Systems Engineering" at the USMA. He is a member of the Army's R&D Officer Program.



MAJ Geiger explains design of throttling rod to cadets.

WECOM engineer Richard C. Maguire discusses "minigun" with Cadet Richard A. Redd during U.S. Military Academy class.

Lesson objectives in this block are emphasized in the cadet's first design problem. This past year cadets were told that the fastener on the present 45-caliber pistol holster has been determined to be unsatisfactory (a hypothetical situation) because the buttonhole in the leather flap enlarges through use, causing the flap to open unexpectedly (an actual situation).

Design teams of three to four cadets are required to determine the best solution to this problem, either a modification to the existing holster or a design for a new fastener, and present their solution in a briefing to the class.

This particular design problem, while apparently trivial, was especially useful in teaching proper use of design criteria. For example, some teams did not consider the criterion that the fastener must withstand the dirt and mud in the environment of the machine gunner, who is also armed with the pistol. They concluded, at least until the briefing, that the intricate fastener on the Military Police holster would do nicely.

Others failed to consider the effects of noise when opening a holster in close proximity to the enemy and were quick to recommend the new (and somewhat noisy) pressure fastening tapes, such as VELCRO. Some interesting impromptu speaking was observed during the final briefings when cadet design teams were confronted by such essential criteria in this "simple" design task. One recommended solution, plastic impregnation of the leather buttonhole to improve wear and resistance to distortion, was forwarded to the Army Weapons Command where it is being tested.

Details of each of the weapon component subcourses in the block diagram probably need not be discussed here. Every attempt is made to stress the interrelated nature of various weapon system components within the weapon system.

For example, after cadets design a gun tube, they are asked to design a modification to an existing recoil mechanism (a new throttling rod), which will provide for a proper recoil distance when the two components are coupled.

Similarly, after studying the nature of rocket flight, cadets are required to determine a rocket thrust required to hit a target 1,500 meters distant between three and five seconds for a rocket fired from the same gun tube. They are then required to design the rocket nozzle to deliver this thrust. (A nozzle is constructed and test fired to confirm theoretical results.)

By connecting the separate design problems in this way, cadets understand how changes in the design of one component cause changes in the performance of others. Ideally, the cadet gains an appreciation of the total analysis which is needed if the over-all system is to be optimized.

Two other characteristics related to the subcourses are worthy of mention, as they both contribute to the unique nature of the course—classroom procedures and the guest lecturer program.

A typical class begins with 15 to 18 cadets seated at desks arranged in horseshoe fashion about the instructor. The instructor usually covers some of the main points of the lesson for 10–20 minutes, after which cadets informally discuss the lesson with the instructor.

All cadets are asked to stand at the blackboard and work a particular problem which outlines the engineering principles just discussed. On completion of this "boardwork," the instructor usually selects two cadets to explain their solutions to the remainder of the class. Then, as often as not in "Weapon Systems Engineering," the instructor issues a printed 30–40 minute test to each cadet. An informal critique of the test solution completes the 80-minute class.

This routine is supplemented by a guest lecturer program designed to illustrate how theory is applied, and limited, in the actual business of weapons development. This past year cadets heard four distinguished guest speakers active in hardware development for the Army:

• Martin B. Chase, chief of the Selected Ammunition Technical Division, Office of the Project Manager for Selected Ammunition, spoke to the cadets on some of the fundamentals of munitions design, with emphasis on the role of mass production on weapon cost-effectiveness ratios.

• Richard C. Maguire, distinguished small arms authority with the Engineering Support Directorate, U.S. Army Weapons Command, discussed the Army's small arms program, and organized a weapons display for the cadets in cooperation with various civilian weapon development agencies.

• Joseph B. Hayes, chief engineer for the U.S. Army Tank-Automotive Command, and contributing editor to *ORDNANCE* (Tank-Automotive News), spoke on developmental problems of tank-automotive materiel.

• The final speaker of this series was the renowned nuclear physicist Dr. Edward E. Teller, who spoke on the role of technology in national security. Such distinguished speakers not only provide reality to classroom theory; they create a needed awareness of problems in our defense posture.

The series of weapon component subcourses is concluded with a realistic student exercise called the "Weapon Systems Design Study." This 8-lesson study forces the cadet to evaluate performance trade-offs which a project manager or project engineer must face in the development of any system.

The study is something of an engineering play in which teams of five to seven cadets act as engineers on the staff of an Army Materiel Command project officer. Realistically introduced in a T.V. program, he has published requests for proposals for a new self-propelled assault weapon. The weapon is to have an antitank-missile capability as well as a large-caliber, indirect-fire gun.

The job of the cadets is to determine, from engineering drawings and specifications received from three contractors, how the three weapon prototypes are expected to perform. Teams are also required to recommend a course of action to the project manager.

Cadets complete this study in six regular class periods and present their conclusions and recommendations to the project manager (actually a board of officers) on the seventh day in a formal briefing and in a written report. The eighth day of the exercise is used for a critique.

The depth of a part of this study should be illustrated. In order to determine the range of the weapon's antitank missile, the thrust of the rocket and the burn time of the propellant must first be calculated from the propellant chemistry and the nozzle and propellant geometry. Once the thrust is known, the equation of motion modeling the missile's flight (a nonlinear, second-order differential equation with variable coefficients) is solved, either on the analog computer or using an analog simulation scheme on the digital computer.

Finally, lest common sense be neglected in all the mathematics and computer programing, at least one missile succeeds in flying the necessary 3,000 meters but has, at least according to the drawings, only 2,000 meters of guidance wire!

The term-end examination follows the "Weapon Systems Design Study" and concludes the course—for all except the honor graduate. The cadet with the highest academic standing in the course for the year reports to the Awards Convocation to receive the COL James L. Walsh Memorial Award, presented by the American Ordnance Association. The award this year, a fine watch, was presented to Cadet Stephen J. Skoog of Salem, Ore., by MG (Ret.) William K. Ghormley, secretary of the association.

To 2LT Skoog and the other 212 new lieutenants who accepted and passed the challenge of "Weapon Systems Engineering," we say, "Well done." They may not be engineers in the conventional sense, but they are keenly aware of the engineering problems in weapon design. That awareness may benefit us all as some rise to positions of responsibility in weapons development.

Army Stresses R&D in Pollution Control Program

By MAJ Jerry L. Gregg

Environmental quality problems facing the Army are as complex and far-reaching as those faced by any single organization in the world. We have not only our share of the same problems facing the civilian community but, due to our unique mission, we have our own set of special pollution problems.

Military operations may generate emissions in the form of gaseous pollutants, ranging from the combustion products of incinerators and power plants to nitrogen and sulfur oxides from ammunition production facilities.

Compounding the pollution control problem are liquid wastes, such as "normal" sewage and a wide variety of industrial chemicals; also, solid wastes ranging from paper containers to outdated munitions.

Other factors are noise from vehicles, weapons and other equipment, and electromagnetic effects, primarily in the form of laser and microwave radiation.

Impacts are made on our air, water and land which must absorb these emissions, often to their detriment. The Army R&D abatement and control program mirrors these problems and attempts to minimize the production and effects of these emissions.

Specific areas involved run the gamut from development of standards to evolvement of new or improved methods of monitoring and controlling polluting emissions from military construction, facilities operation, materiel development, and industrial production.

In seeking solutions to these problems, the first step is to determine the efforts being made by other organizations and to evaluate them. If these efforts are nonexistent, not adequate, or do not address the military aspects of the problem, our own projects are initiated, or occasionally, joint projects with other organizations may be established.

The National Environmental Policy Act of 1969 has become the compelling force in the massive efforts currently under way to create and maintain conditions under which man and nature can exist in productive harmony.

Implementation of the provisions of this act through a number of executive and defense directives has levied certain requirements upon all the military services. Executive Order 11507 requires federal agencies to take the lead in protecting and enhancing our air and water resources.

Chief of Staff Memorandum 70-323 requires the Army to comply fully with both the requirements and the spirit of EO 11507. In addition, this memo tasks the Chief of Research and Development to review Army R &D activities which contribute to the control and abatement of environmental pollution.

A further requirement is to insure that R& D programs fully support the goals established by Public Law 91-190 and the executive orders.

Near-, mid-, and long-range objectives have been identified. In the near-range, the objective is to identify and measure the problem; also, to establish interim practices for monitoring and controlling emissions associated with materiel development, industrial processes, and facilities construction and operation.

Concurrently, a major research effort, including some basic research, is being initiated to support the long-range objectives. The mid-range goal includes establishment of baselines, advancement of technology through development, and updating of practices.

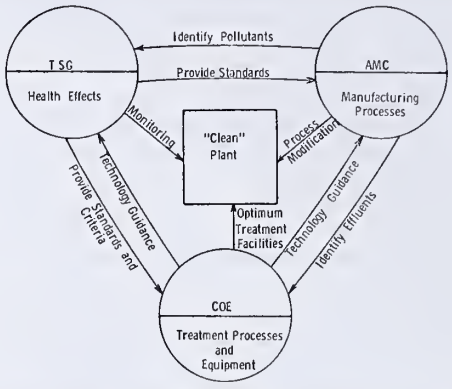


Figure 1
R&D Environmental Quality Control For Ammunition Plants

For the long-range objectives, new materials and new processes will be developed on a total system, cost-effective basis to minimize adverse environmental impact.

The program includes efforts by the Office of the Surgeon General (OTSG), Corps of Engineers (COE), and Army Materiel Command (AMC) which are related to their overall respective responsibilities. These efforts are mutually interdependent and coordinated.

A good example of the interaction of the programs of the developing agencies is support of ammunition plant operations as shown in Figure 1. The AMC identifies to the OTSG the specific pollutants for which standards must be established. The AMC also is conducting research on manufacturing processes to develop modifications that will reduce emissions. Expected types and quantities of effluents are identified to the Corps of Engineers.

OTSG researchers develop the necessary standards and criteria for the identified pollutants and provide these to the COE and the AMC. In addition, the required monitoring capability is developed. The COE uses the input from the OTSG and AMC to develop breadboard models of treatment processes for effluent control.

The coordination loop is closed by feedback of information to OTSG and AMC of the treatment technology advancement. The anticipated outcome is a "clean" plant through the inputs as illustrated--process modification, optimum treatment facilities, and comprehensive monitoring.

The Surgeon General's program is related to health aspects and has the primary output of standards and criteria for Army-unique pollutants. In addition, the requirement for monitoring to insure that health hazards do not exist, or to define the extent of the hazard involved, entails development of procedures and instrumentation sufficiently precise and sensitive to make these determinations.

Effluent standards must be established for Army-unique pollutants, most of which are associated with ammunition manufacturing. The Environmental Protection Agency (EPA) can and, in fact, is mandated to establish standards for all effluents.

Experience has shown, however, that standards tend to be overly conservative when the effects of the pollutant are not well understood and documented. For this reason, a concerted effort is being undertaken to provide this documentation for Army wastes and to suggest reasonable standards acceptable to EPA. This entire effort is being closely coordinated with EPA.

In the area of direct wastewater reuse, the Army is conceded to be far ahead of the civilian community in that equipment is ready to be fielded that can produce potable water directly from selected wastewaters.

Lacking, however, are health standards or standardized monitoring techniques to ensure the potability of such water. The EPA has responsibility for and is currently developing such standards, but has not done so and is moving very cautiously in this direction.

To forestall delay in utilization of this advanced equipment, and to fulfill his responsibility for protection of troop health, development of standards has been undertaken by the OTSG, in close coordination with the EPA.

Information and standards developed from this joint effort will be of great value to civilian communities when they are faced with the prospect of directly recycling waste-water.

Wastewater analysis sets are being developed jointly with the AMC. These kits are to be used by COE and OTSG personnel for water/wastewater analysis in the field. Information is being collected to assist development of analytical procedures and surveillance instrumentation for various applications.

Efforts are also under way in other areas. Health effects of spray irrigation of wastewater are being investigated at the request of the Chief of Engineers. Newly initiated is a study of the chemistry of bromine, which has several advantages over chlorine as a disinfectant; however, until the decomposition and disproportionation reaction are understood, and a simple residual determination is available, bromine cannot be effectively utilized.

Membrane ultrafiltration, foam separation, carbon absorption, and hydrocycloning are unit processes whose application to treatment of military wastewater is being investigated.

Basic understanding of the mechanism of action is required for meaningful evaluation of the processes. Information being developed is passed on to the Corps of Engineers and AMC for utilization in hardware development.

Deseret (Utah) Test Center will assist in developing models for optimization of air pollution monitoring networks. Pesticide disposal must be evaluated to determine methods acceptable from a health and environmental point of view.

Electromagnetic radiation research, a program still somewhat in its infancy, is divided into four principle areas: dosimetry and instrumentation; behavioral effects; eye effects; and central nervous system effects. The bulk of the current effort is aimed at consolidating present knowledge and establishing a firm base from which to expand.

Environmental noise has become recognized as another form of pollution the Army must address. In the past, most research re-

lated to military noise was directed primarily at characterizing highly specilized subelements of the operational environment, such as aircraft and crew compartments of armored vehicles. This work is being expanded to include more general man-noise relationships.

The Army Materiel Command, being the industrial manager for the Army, is confronted with pollution problems as diverse as Army materiel itself. AMC's program is 2-pronged. One goal is to develop materiel which has minimum environmental impact associated with its use, consistent with operational requirements. The other approach involves controlling pollution from the production and maintenance facilities supporting the materiel.

One of the major efforts has been related to munitions production. Investigations have ranged from evaluating alternative raw materials, to modifying current processes, to development of entirely new processes. Innovative physical-chemical as well as biological approaches are being investigated to determine more effective treatment methods for wastes from a wide variety of industrial operations.

A combination chemical-biological treatment developed for nitrocellulose wastes demonstrates the approach that may be required to dispose of the "tough" organics, or ones that do not readily break down. The waste is pretreated chemically to change its structure to make it more amenable to biological degradation.

Engine emissions from our wheeled tactical vehicles must comply with current and future standards. Developmental work in this area is continuing. While the Army relies on commercial manufacturers to supply certified engines for most equipment, there are a few engines which are the sole responsibility of the Army. One example is the engine for the ¼-ton vehicle. A stratified charge "hybrid" engine has been developed for this vehicle, which is one of the best candidates to date for meeting the 1976 EPA emission standards.

A complicating factor for military engines is the Department of Defense direction to convert to the use of low-lead fuels. Conversion of the entire Army fleet of gasoline engine vehicles to such fuel may cause maintenance, lubrication, drivability and durability problems. Investigation is under way to determine if such problems will be encountered.

Alternative formulations of various solvents, paints and other organic materials used by the Army have been developed to decrease pollution but retain their effectiveness. Revised procurement specifications have been issued for 19 high-use products.

Evaluation of the applicability of various unit processes to mobile equipment for treating a wide range of liquid and solid wastes has been initiated. Reverse osmosis has shown considerable promise as an effective and versatile process for use in such equipment. Small modular sewage treatment systems are being developed for Army water craft.

Emissions from Army aircraft are being characterized. Noise levels, particularly from rotary-wing craft, are being investigated to determine design changes and control devices.

Packaging materials pose a peculiar problem. While there is a requirement to develop materials that will withstand extreme environmental conditions, this property unfortunately tends to make them extremely resistant to normal disposal methods. Considerable effort and various approaches to disposal will be required.

The Army Corps of Engineers pollution control and abatement program is related to military construction and facilities management. The effort is concerned with experiments and development of breadboard models for new construction techniques, materials and hardware used to build and operate Army installations.

All aspects of facilities management are being considered. Designers and construction supervisory personnel must be provided with the means of assessing the environmental impact of various construction operations; also, to develop and evaluate methods and equipment for abating or eliminating such impacts.

The Engineers' R&D of wastewater recycling methods includes investigations not only of direct reuse but of such closed-loop processes as spray irrigation and ground water recharge. Development of advanced waste systems will be directed to the optimal mix of various unit processes to achieve the most efficient treatment for a given wastewater.

The corps is working on a total facility system concept for utilities to achieve more efficient utilization of resources and lower emission of pollutants. Better solid waste management principles will be applicable to normal refuse and trash as well as to construction site debris and solid industrial wastes.

Another area of concern to Army engineers is development of sewage treatment systems for cold regions. A small single tank sewage treatment system for Arctic use has showed such promise that the concept is now being evaluated, with the help of the Navy, in a much larger plant size than had been contemplated in initial development.

With the impetus of an increased awareness of pollution problems, and increasingly stringent emission standards, Army research effort has expanded substantially during the past two years. In FY 71, and earlier, contributions to pollution R&D were largely spin-offs from projects whose primary purpose was something other than pollution abatement.

In FY 72 the program became more viable with the establishment of separate projects and tasks and funding in excess of $8 million. For FY 73, the Army has asked the Congress for a total environmental quality package of $21 million.

During FY 73 and FY 74 considerable expenditures will be required to overcome the lag between technology and standards requirements. Thereafter the effort is expected to decrease but is anticipated to stabilize between $10–$15 million. This will be required to advance the technology to keep pace with anticipated increasingly stringent controls.

In summary, the U.S. Army goal is to provide the R&D to satisfy the requirements and spirit of Public Law 91-190 and the implementing directives. The program under way is comprehensive, exhibits leadership in several areas, and should satisfy the Army's goals.

WSMR Marks 25th Anniversary Of Aerobee Sounding Rocket

Launching of an Aerobee 200 sounding rocket from White Sands (N. Mex.) Missile Range (WSMR), recently marked the 25th anniversary of this atmospheric research instrument, which attained an altitude of 47 miles on its initial flight in 1947.

Ceremonies were sponsored by the Research Rocket Branch of the Naval Ordnance Missile Test Facility and the WSMR Sounding Rocket Scheduling Committee. Civilian and military community representatives associated with the Aerobee Program at WSMR were in attendance.

Aerobee was the first rocket to carry a living being into space. In 1951 and 1952, rhesus monkeys were transported aboard the vehicle. As an invaluable instrument in high-altitude and near-space research, it has been used in photographic missions, physics studies, micrometeorite experiments and satellite and missile subsystems tests.

Rocketborne experiments have gained scientists a vast amount of knowledge of the earth, upper atmosphere, ionosphere and solar phenomena. Principal advantages of Aerobee rockets are their reliability, low cost per payload mile and "soft ride," which safeguards delicate research equipment.

MAJ Jerry L. Gregg is assigned to the Life Sciences Division, Office of the Chief of Research and Development (OCRD), HQ DA, with responsibility for coordinating the over-all Army R&D program of environmental improvements.

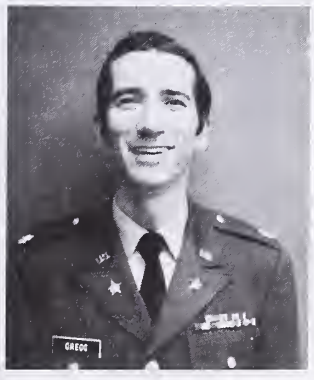
He graduated in 1962 from Rose Polytechnic Institute, Terre Haute, Ind., where he earned a BS degree in chemical engineering and was commissioned a second lieutenant in the Medical Service Corps (MSC) through ROTC.

After attending the MSC Basic and Environmental Engineering courses at Fort Sam Houston, Tex., in 1963, he was assigned to the Medical Field Service School there as an instructor in the Department of Preventive Medicine.

In 1966, MAJ Gregg earned an MS degree in environmental and sanitary engineering from Washington University, St. Louis, Mo. Following graduate school, he was named chief of the Water Pollution Control Branch, U.S. Army Environmental Hygiene Agency, at Edgewood Arsenal, Md.

From 1967 to 1968 he served as staff sanitary engineer, 712th Preventive Medicine Unit in Korat, Thailand, where his major efforts were directed toward characterization of waste water effluents from ammunition plants.

Before joining OCRD, MAJ Gregg was assigned as General Sanitary Engineering and Safety Consultant in the Office of the Surgeon General, Washington, D.C. In that capacity, his areas of interest were potable water standards, field waste disposal, food service sanitation, hospital safety, and swimming pool standards.



ABMDA Uses In-House Resources for Feasibility Studies

By Herbert N. Cohen and Willard W. Perry

Agencies responsible for planning and directing advanced weapon system developments are faced with the continuing task of analyzing and evaluating new system concepts and technologies. To ensure rapid advancement of the state-of-the-art, these advanced R&D agencies must carefully screen all new ideas to determine whether the concepts merit further research or development.

The use of systems analysis to determine early if proposed concepts have potential systems value is an effective means of conserving R&D funds by eliminating impractical concepts. Furthermore, early systems analysis to define the key issues associated with promising concepts is necessary to determine how best to proceed with investigations.

To be effective, these screening and planning analyses must be performed by the responsible agency. Requirements for timeliness and responsiveness to the agency's needs do not permit the delays and lack of direct control associated with contracting.

Furthermore, the objectivity and independence from self-interest required for these types of evaluations are most readily found within the agency. Finally, the need for integrating the results into the agency's plans calls for insight and understanding of the analysis that can best be attained through actual performance of the analysis.

The need for a broad technological base makes it difficult for the agency to assemble and maintain the necessary skills and manpower to perform these screening analyses entirely in-house. A complete internal staff having the necessary technical breadth would be cumbersome and inefficient; it would tend to become technically stagnant, not having the benefit of fresh ideas and techniques that come from contracts.

To overcome this dilemma, the U.S. Army Advanced Ballistic Missile Defense Agency (ABMDA) has developed a contractor-supported in-house systems analysis program that exhibits the advantages of both in-house and contractor efforts without containing the disadvantages of either.

The essential idea is the use of *a team of three separate and distinct groups* to perform the systems evaluations. Assigned differing responsibilities, the groups work together to provide a quick-response, broad-based analytical capability for evaluating advanced concepts and technologies.

Members of the team and their responsibilities are shown in Figure 1. Foremost is the *in-house unit* consisting of a small number of senior systems analysts supported by one or two General Services Administration (GSA) analysts and programers. The unit provides complete technical control and integration of the analysis, from formulation of the general problem to the final results.

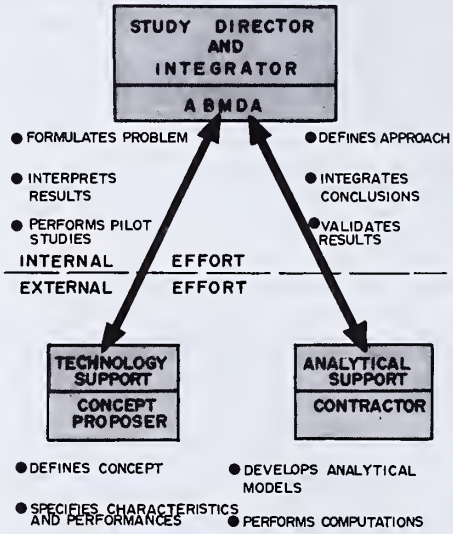


Fig. 1. ABMDA In-House Systems Analysis Team

Responsibilities of the in-house unit include defining the detailed approach to be used in keeping with time and budget constraints, setting up the system of equations or models to be implemented, specifying the computer runs to be made, interpreting the results and, finally, developing the rationale and the program for additional work.

Key requirements for this unit are a willingness and a capability for getting involved in day-to-day analytical decision-making, and an ability to sort through the complexities of the problem to define the key issues.

For a thorough understanding of the analysis and its results, it is essential that the in-house unit "gets its hands dirty"—that it takes an active role in the analysis to the extent of deriving the equations and performing trade-offs to decide what parameters are important.

In fact, for the smaller problems, this unit will perform the entire analysis itself. For larger problems, the unit may find it necessary to build and exercise pilot models to obtain the insight and understanding needed to define the detailed approach to the evaluation.

The *analytical support unit* of the team provides the analytical and model-building expertise required for more detailed in-depth analyses. This unit consists of a contractor who develops systems models (under the in-house unit's direction) and performs computations as required. It does not perform independent studies but always works to satisfy week-to-week requirements placed upon it by the in-house unit.

The *technology support unit* provides the broad technology base required to perform the evaluations. It supplies data on technology and engineering characteristics of the concept being studied. This member of the team changes as the system concepts and technologies under investigation change.

Usually, the contractor who proposed the new concept being studied can best supply this type of information; however, government laboratories and arsenals serve as the technology support unit when possible.

This 3-pronged team effort accomplishes the difficult task of bringing to bear, in an in-house program, the wide range of analytical and technical skills required to perform satisfactorily the new concept systems evaluations.

The requirement for only one or two systems analysts within the agency eliminates the problem of acquiring and maintaining a large staff of programers, model builders and technologists. Furthermore, the analysts do not have to spend their time managing personnel. They can devote essentially all their time to directing and integrating the study efforts.

An additional benefit of the in-house systems analysis program is that it enables participation on a technical working level with other members of the ballistic missile defense community, both governmental and industrial. To illustrate, during the past year four papers were presented at national symposia, describing results of the in-house contractor-supported studies.

The types of analyses that are performed under this in-house contractor-supported effort greatly assist ABMDA's planning and decision-making efforts. Four general types have been performed, classified as to use of the analysis:

- New concept evaluation to determine potential systems value and provide basis for decision for further study (new concept screening);
- Definition of key issues to be studied further (contract definition support);
- Evaluation of competing concepts on common grounds (defining preferred concept);
- Validating contractors' claims and results (independent analysis of key issues).

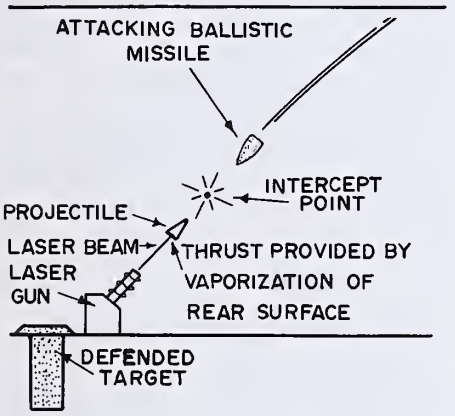
A few examples of the systems analyses performed by ABMDA will illustrate how the studies are carried out, and demonstrate the value of the in-house contractor-supported effort in solving a wide range of problems. The illustrations are meant to demonstrate the flavor of the work performed and not to provide detailed and complete descriptions of the analysis and results.

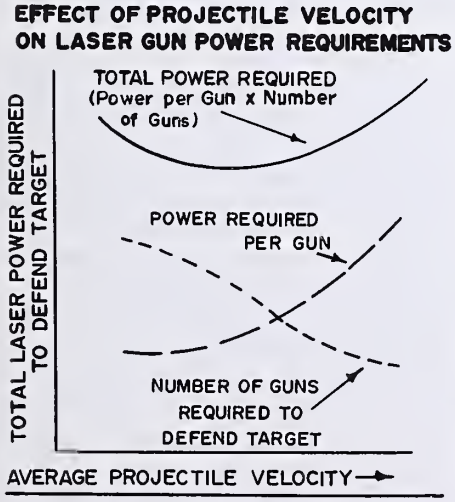
Laser Propulsion Concept Evaluation (new concept screening).

The in-house systems analysis staff was tasked to investigate the potential systems value of a proposed ballistic missile interceptor concept which uses lasers to propel and guide nonnuclear projectiles. The laser propels the projectile by vaporization and high-velocity blow-off of the rear surface of the projectile.

The question addressed was: *Could the concept be economically practical and effective, assuming it were technically feasible?*

The purpose of the evaluation was to provide a first-level screening of the concept in ABMDA's decision-making process. If the evaluation showed that the concept was not practical, then no further effort need be expended; if the concept showed some promise of cost-effective application, then the feasibility investigation would proceed. Figure 2 illustrates the concept studied.





Questions Addressed in Evaluation:

- **Assuming technical feasibility, can concept be cost effective in system application?**
- **What technology and performance requirements are necessary for cost-effective application (e.g., laser beam width, projectile accuracy)?**

Fig. 2. Laser Gun for Hard Point Defense

Illustrated also is the derivation of one of the key system parameters used in the evaluation of the concept. In this case, the parameter is the total laser power required to defend the target against a multiple RV attack, and it is shown as a function of projectile velocity. This power is an indication of the practicality of the concept and is the product of the number of guns required and the power per gun.

As shown, the required power per gun increases and the number of guns required decreases with average velocity. The former occurs because, as the average velocity to an intercept point increases, the time of flight must decrease. To reach a specified level of projectile kinetic energy required at the intercept point in the reduced flight time, more power must be supplied to the projectile.

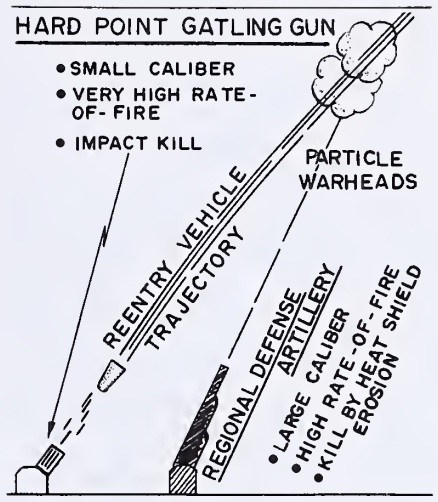
In carrying out the analysis, the study director (in-house team member) initiated the analysis by discussing the concept with the proponent group (technology support team member) for the purpose of understanding its operation and critical features. After identifying the key system parameters which would serve as the measures of economic feasibility, he developed the detailed analytical approach and models required for evaluating these system parameters.

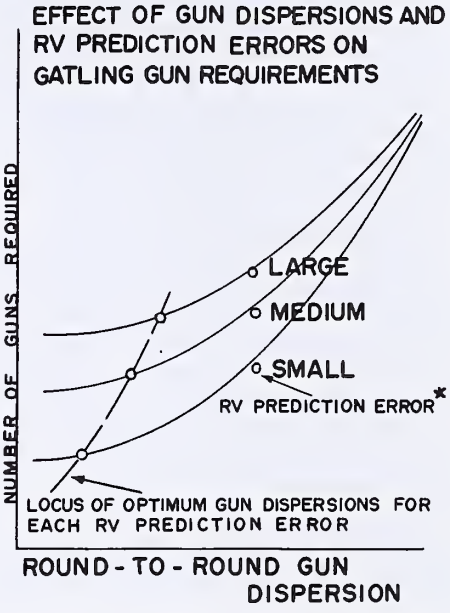
The principal considerations in the approach were the assumptions to be made that would enable the analysis to be conducted in the required time, yet would yield valid conclusions. Analytical models were built and implemented in-house, using physical data supplied by the technology group and model building support from the analytical group. Finally, the technical director analyzed the results and arrived at conclusions.

The over-all study was performed in less than a month with less than two man-months of effort. Yet, a unique systems evaluation of a new technology was performed which provided valuable guidance to ABMDA as to how to proceed with the proposed concept.

Antiballistic Missile Cannon Evaluation (evaluation of a wide range of technologies on common grounds).

The ballistic missile defense problem has continually fostered concepts for countering reentry vehicles with various types of cannon and artillery. Consequently, ABMDA receives a number of new antimissile cannon proposals each year, involving new concepts in warheads, fire control systems, rate-of-fire, and the like.





** RV prediction error is shown in RV position at intercept which accrues during flight time of unguided projectile. It is comprised of trajectory perturbations and tracking prediction uncertainties.*

Questions Addressed:

- **Are concepts feasible from cost-effective point of view? (How many rounds, how many guns, and what is the total cost required to defend a target?)**

Fig. 3. ABM Cannon Concepts

These new technologies, combined with changing BMD missions, justify taking periodic looks at these concepts to assess their conceptual feasibility and potential value. These assessments are continuing tasks for the ABMDA in-house/contractor-supported systems analysis program.

In order that the most promising candidates may be selected for more detailed study and development, it is necessary to evaluate them on a common basis. The value of the ABMDA in-house evaluation program is apparent here, where consistent evaluation tech-

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Weapons Systems Analysis

(Continued from page 37)

niques can be developed and used to evaluate a wide range of competing technologies and concepts.

Without this integrating force of the in-house effort, ABMDA would be faced with making decisions on concepts that ordinarily would be evaluated by the various contractors, using differing assumptions and methodologies which may put the proposed technology in a more (or less) favorable light.

The in-house systems analysis team is able to ferret out these discrepancies and provide consistent computations for all concepts studies.

The range of concepts studied is illustrated in Figure 3. Shown also is one of the critical trade-offs used in evaluating the unguided cannon concepts. The two key errors affecting the number of rounds required to intercept an RV are the gun dispersions and the RV prediction errors.

The number of guns required is proportional to the number of rounds required because each gun has a limited firing rate and a limited time to shoot at an RV (i.e., each gun can fire a limited number of effective rounds at the RV).

For a given RV prediction error, the number of rounds required minimizes at a finite gun dispersion rather than at a value of zero. This is due to the aim point bias caused by the RV prediction error associated with each salvo. In the extreme, zero dispersion errors result in all the rounds hitting the aim point, i.e., the predicted RV point which is displaced from the target.

The interesting result is that new technology which only reduces gun dispersion errors is not sufficient, since RV prediction errors must also be reduced if the number of rounds and guns is to be reduced significantly.

Advanced Interceptor Concepts Evaluation (independent validation of contractors' claims).

In addition to screening new concepts and technologies on the basis of their cost-effectiveness potential, the in-house systems analysis team evaluates proposed concepts on the basis of their conceptual feasibility.

This is accomplished by first performing a cost-effectiveness analysis to determine the performance characteristics required for cost-effective system application. The feasibility of attaining the required performance is then analyzed for the system elements of interest.

These preliminary investigations are needed for new concepts which have been conceived and submitted for consideration when there has been insufficient effort to indicate feasibility.

The concepts may have certain aspects that are extremely attractive. It is to the benefit of the ballistic missile defense program to work with the proposer to establish system feasibility of the concept prior to the decision as to whether to proceed or drop the effort.

An example of this type of effort is the investigation made of a new interceptor concept that was recently submitted to ABMDA. The concept consisted of a missile which had been developed for another purpose, and appropriately modified for BMD application.

The in-house systems analysis team first performed a cost-effectiveness analysis. This established that the concept was definitely competitive and worthy of more detailed study, provided that a certain interception accuracy could be achieved.

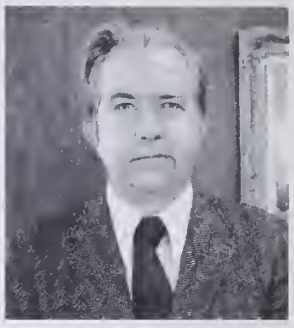
The proposer's claims that the accuracy was achievable were based on the performance of the missile against other than ballistic missiles. Consequently, the in-house systems analysis team performed a study of the proposed guidance concept and found that the interceptor could not achieve the required accuracies aginst ballistic missiles.

The interceptor concept had other features that were still attractive. Hence, at this point, the in-house team decided to work with the proposer to determine if another guidance concept could meet the requirements.

Funding of a more detailed study of the concept is to be recommended when it is determined that these initial feasibility requirements are met. Otherwise the concept will be dropped.

Herbert Cohen

HERBERT COHEN is a senior systems analyst with the U.S. Army Advanced Ballistic Missile Defense Agency (ABMDA), specializing in the evaluation of new concepts and technologies for ballistic missile defense. Since joining ABMDA in 1969, he has received a number of special awards for his work, the latest of which was the David A. Rist Award for the outstanding paper delivered at the 28th meeting of the Military Operations Research Society.



Willard W. Perry

WILLARD W. PERRY has been involved with ballistic missile defense analysis since 1959, first as a threat analyst with General Electric Co., and, subsequently, as a systems analyst with University Computing Co. He is a consultant to ABMDA for W. W. Perry & Associates, Inc.

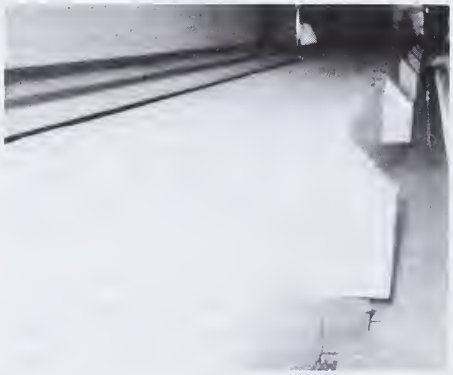
WSMR Opens Optical Instrumentation Test Facility

Compressed air suspends a 132-ton (264,000 pounds), 106-foot solid-concrete optical bench—believed the largest of its kind in the Free World—that is part of a new Optical Tunnel and Laboratory Facility opened at White Sands Missile Range in November.

MG A. H. Sweeney, CG of WSMR, cut the ribbon at opening ceremonies.

Air suspension keeps the optical bench perfectly level and totally isolated from ground effects, though it is in a 125-foot-long tunnel. This complete isolation is critical in testing and aligning optical instrumentation systems.

Testing to extreme accuracies is possible—up to 1/20th of one wave length of light (a wave length is one 100,000th of an inch).



OPTICAL BENCH, 106 feet long and 264,000 pounds, is part of the new Optical Tunnel and Laboratory Facility at WSMR.

A freight elevator and a crane provide easy access to the underground tunnel area for components or complete systems. Both the elevator and the crane, installed above the 5-foot-wide, 4-foot-thick optical bench, have capacities up to 10,000 pounds.

Scheduled testing and alignment of instrument systems include the Distant Object Attitude Measurement System (DOAMS), Versatile Tracking Mount (VTM), WSMR Cinetheodolites, and the growing family of 50-inch, 100-inch and 180-inch focal length quartz photographic objectives. Also planned is testing of remote control and mobile telescopes and event measurement systems.

Use of accurate laboratory mirrors (two measuring 39 inches each; one with a flat surface and the other curved in the form of a parabaloid) with the new bench will more than double its optical length (up to 300 feet)—particularly helpful for special test projects using laser beams. It has also been estimated that test and alignment time may be reduced by 80 to 90 percent.

Until the new bench became available, the largest air-suspended optical bench at WSMR was a 26-foot concrete table.

Construction of the entire facility, including a 7,397-square-foot addition to Bldg. 1506 to include five optical laboratories, began last year as part of phase VI of the Range Modernization Program, at a cost of about $525,000. WSMR now extends support to agencies requiring services of such a facility.

Gateway to Achievement . . .

U.S. Army conducts expansive program of graduate education to develop highly skilled medics for health care program

By COL Richard P. Torp, M.D.

The Army conducts the largest centrally directed program of graduate medical education in the United States, one that is a major part of the comprehensive U.S. system of health care delivery.

Graduate medical education, internship and residency is a continuation of the education of a physician from the classroom to the hospital. By tradition, the MD degree is awarded upon graduation from medical school, but no physician is competent to practice his profession today without serving this period of professional apprenticeship.

The duration of this phase of a physician's education may be anywhere from one year of internship for those who become general medical officers to six years of residency for some surgical specialists. It is worth noting, in this context, that the one-year internship is becoming ever less adequate.

The Army heritage in medical education began in 1775, the first year of the American Revolution, when Dr. John Morgan became chief of the Army Medical Department. Dr. Morgan was the founder of the first medical school in the United States, the school that is now the University of Pennsylvania.

The first Army internship program began in 1921 in an era when general practice predominated in American medicine. World War II, through the classification of specialists in the Army Medical Corps, encouraged the rise of specialization in this country. The first Army residencies for the training of medical specialists began in 1948.

The Army graduate medical education program has since grown to encompass 1,136 Medical Corps officers, exclusive of their teachers. At present, there are 199 interns and 886 residents and fellows training in Army hospitals. Six Army Medical Corps officers are in residency training in Air Force and Navy hospitals, and 45 are taking advanced fellowships at civilian university medical centers under Army sponsorship.

More than 100 separate residency programs in Army hospitals can lead to certification in 35 specialties ranging from cardiothoracic surgery to family practice. Twenty percent of Army Medical Corps officers are enrolled in these programs, which are the training ground for the career Medical Corps and for the highly skilled medical specialists serving the Army worldwide.

These training programs are conducted at eight Army teaching hospitals, and the seven largest are closely comparable to the major university medical centers. Their training function is broader in scope, since they are referral centers for the Army worldwide. They provide the most sophisticated treatment available anywhere in the Army health care system, such as open-heart surgery or kidney transplantation.

The Army training programs are approved by civilian accrediting agencies and the teaching hospitals have affiliations with nearby medical schools. Medical Corps officers are full-time medical educators. Many of them hold faculty appointments at medical schools; they have representative positions in many professional societies and medical specialty certifying boards.

Since Army teaching hospitals are referral centers serving the Army from all over the world, the spectrum of clinical experience available to Army interns and residents at these centers is wide. Malaria, for example, is virtually unknown at civilian hospitals, but Army residents in internal medicine have acquired considerable experience with it.

Other unusual opportunities are available to the Army physician in training. Residents in pediatrics are sent for 90 days to Bangkok, Thailand, and residents in internal medicine are sent for 90 days to Kuala Lumpur, Malaysia, for training in tropical diseases. Army ophthalmology residents spend 90 days in Lima, Peru, for intensive experience in eye surgery.

A Visiting Resident Program authorizes one officer a year from each residency program to visit a civilian or military medical center of his choice for two weeks on temporary duty. Conversely, a Visiting Professor Program brings two eminent medical educators for one week to each Army residency program.

Fully trained Army medical specialists may be selected to attend civilian universities for even more advanced fellowships or higher education leading to master's or doctor of philosophy degrees.

The importance of clinical investigation as an essential element of graduate medical education has been recognized by many medical educators. The ultimate in quality health care is delivered in an atmosphere of scholarly inquiry essential to the training of physicians.

Each of the seven largest teaching hospitals has a Clinical Investigation Unit directed by a senior Medical Corps officer who has a background in research. The seven Clinical Investigation Units annually review about 350 protocols a year that lead to over 100 publications or conference presentations.

Expansion of the program this year is planned to include some of the smaller hospitals. The present program is authorized 100 personnel spaces and has a FY 73 budget of close to $1,000,000.

The clinical investigation program is in addition to and separate from the U.S. Army Medical Research and Development Command. To insure maximum effective utilization of resources, however, The Surgeon General has, in many places, collocated facilities of the Medical Research and Development Command with teaching hospitals.

This arrangement permits close association and in some cases a dual assignment for those involved in physician education and those engaged in basic research. The result is efficient utilization of unusual talent, enhanced professional training and better patient care.

Army graduate medical education contributes immeasurably to the stature of Army medicine and is a source of pride to all Army Medical Corps officers. With the disappearance of the doctor draft, these programs will assume even greater importance as they become virtually our only source of fully trained physician specialists.

COL (Dr.) Richard P. Torp, MC, is chief of Graduate Medical Education, Office of the Army Surgeon General (OTSG). He earned AB and MD degrees from Temple University.

His military schooling includes the Basic Airborne Course at Fort Campbell, Ky., Career Officers Course at Medical Field Service School at Fort Sam Houston, Tex., and the Army Command and General Staff College.

COL Torp has authored or coauthored numerous articles appearing in various medical journals. A member of the American Medical Association, and the International Society for Education in the Health Sciences, he is a Fellow of the American Academy of Orthopaedic Surgeons, and the American College of Surgeons. He has served two tours of duty in Vietnam and as assistant chief surgical consultant (Orthopaedic Surgery), OTSG, HQ Department of the Army.

SPEAKING ON . . .

Increasing Defense Electronics Productivity

(Continued from inside front cover)

flexibility in design specifications. We first build up experience through tradeoffs and feasibility work; then we award cost-reimbursable development contracts, with incentives; and finally we have a competitive prototype "fly-off"—all prior to a production decision. At each step, we minimize the risk to both the supplier and the government and we establish confidence before moving ahead.

The design-to-a-price practice is spreading and it's working. One of the most exciting aspects of this concept is that the industrial engineers are truly stimulated by the added challenge. The design-to-a-price incentive drives them. They don't stop when they have satisfied the performance requirements. Instead, they go on to invent elegantly simple, low-cost and highly reliable new ways to do the job. They've tried it and they like it!

In addition, the government program manager understands that the success or failure of his development program rests, to a significant degree, on the resulting acquisition costs and projected maintenance costs of his equipment. He knows that his system won't be bought if he does not end up meeting the design-to-a-price goals.

There are problems. One is the hard question, "what price?" Thorough analysis, at the cost of time and money, must be completed prior to initiating new engineering development projects. In this way, we will have a viable design price which in our judgment will provide high performance, quality and numbers, at a price we can afford—and at a price we know can be met by competing contractors.

Setting the "right price" will take hard work, time and wise management judgment. Experience shows, however, that together we can arrive at practical and affordable values for the system performance we need. Remember that it is the existence of this price, as an incentive to the industrial design engineer and the government program manager, which is of primary concern.

Let me give an example of where we are today and where we could be. In air-to-air radars, the current systems cost $500,000 or more, and have a field reliability of less than 20 hours, some much less. Industry has shown us early prototype equipment which, if their claims are proven, will satisfy our performance needs, and which is designed to cost $200,000 and have a field reliability of 100 hours.

How do we know this is not just another industry claim? Maybe it is. However, our analysis of the approach planned, and our in-house parametric estimates of the product, cause us to be convinced that the values are in the right ballpark. In addition, prototyping and flight testing will help to validate the claims.

Turning now to standardization; this is primarily a Department of Defense management problem. It is a very tough problem, I admit. Its solution will undoubtedly lead to some criticism of the actions we will have to take. The need for it is demonstrated by the proliferation of electronic equipment.

Standardization will result in higher volume production, therefore lower cost and higher reliability, while at the same time greatly reducing the logistics and training costs. The savings can be substantial.

There are two essential elements of standardization: first, standard interfaces that would allow us to employ standard devices, separately acquired; and, second, the ability to maintain multiple sources, particularly of critical components and replaceable modules. We are not making optimum use of either element.

Ladies and gentlemen, standardization is *not* a dirty word. We realize there are significant barriers to its implementation, so we must organize for it, and we must insist upon it. It must become "institutional" in order to be effective, not a one-shot or a one-Service experiment. Implementation will be difficult, but the potential rewards of standardization, properly applied, demand greater efforts.

Here, again, we must start with general requirements. If the need is stated in such detail that no existing or developing systems or subsystems can qualify, then proliferation will continue. Thus, the requirement must be both flexible and sufficiently general to allow consideration of standard equipment.

So, specifications must be written to encourage standardization. We are interested in the end product's field performance and interfaces, not in the details of the "insides." The designer must be allowed flexibility if both standardization and design-to-a-price are to work.

To aid in the cost-versus-performance tradeoffs, as well as to aid in standardization, we might consider the technique used by the commercial airlines in establishing electronics specifications.

Prior to the final request for proposal, the airline engineering group (under ARINC) calls together the suppliers and the users. They go over the stated requirements, and they collectively trade off the added costs versus each desired feature. They establish the standardized interfaces. Finally, a functional and interface specification is written.

This close coupling at the requirement end has proven extremely successful, and we must consider seriously its potential in defense developments.

Let me indicate one example of our failure in an area that could benefit greatly from standardization—tactical UHF radios. These radios perform the same functions in four environments—shipboard, vehicular, ground and aircraft. We have developed different equipment for each of these environments.

What's worse, within each environment we have developed different types. Even within the same platform type we have different models of the UHF radios. There are at least 10 different airborne UHF transceivers of the same vintage employed in our forces today, all performing the same function.

Recently, we started a new procurement of a standardized unit. But why had this situation developed? You know the answer. Each program manager of a new weapon-system development has wanted his equipment to be as good as the state-of-the-art allows, and you in industry tell him he can have it when he needs it, right from your "new equipment shelf."

So we believe you, and we get another new piece of equipment which is unproven, and which will never be built in large enough quantities to get the cost low enough and the field reliability we need. We don't reach the stage of large quantity production because, as soon as the next new weapon system is developed, you and we initiate the whole cycle all over again.

Well, let me assure you that this practice is going to stop. You know the pinch the Congress is putting on the R&D budget. I suggest that you review your current R&D programs to see whether they satisfy the design-to-a-price and standardization objectives. Because, if they don't, you're not likely to make it.

A very significant aid to standardization, which we are considering, is to develop and test prototype subsystems as separate procurements, aimed for several weapons. When proven, they would then be available for general weapon system use and not be tied to a single proposed new weapon. There would be minimum risk in this approach—technically, financially and in delivery.

These independent subsystem developments would have a general set of requirements and a design price associated with them. Their electrical and mechanical interfaces would have to be standardized, and the weapon systems would use these same standards. The equipment would be competitively procured from at least two suppliers.

By following this approach, we would have at least three options available at the time a new weapon system development is decided on: to buy more of the current subsystems; to improve the current subsystems; or to buy the newly developed subsystem from one of the two or more proven suppliers.

Finally, in pursuing this concept we must ensure that there is always technology for a "next generation" subsystem in development, offering continuing improvements in cost, reliability and performance.

Frankly, our problem in this area is again a Defense Department management one. We need DoD recognition and institutional restructuring for independent subsystem developments in order to receive funding and strong support. We will certainly have to have a notional weapon system application in mind; however, we are too often driven by a specific weapon system schedule or its contractual requirements.

Where a specific weapons system has been identified, there has been a tendency to trade off development time and money to meet the specific system schedule or budget. This has historically caused high cost and poor reliability. We must insist on adequate time and money to develop and test these new, standardized subsystems if these problems are to be avoided.

The problem is aggravated by too much overlapping of our own technology centers of excellence. It is simply a case of too many people doing other people's business. We must affect more consolidation of our in-house capability.

There will, of course, always be a need for the development of some equipment which is designed specifically to advance the state-of-the-art in one area or another. Too many of you are probably thinking—"finally he's talking about my equipment"—well, let me warn you, your equipment may or may not be in this class. If it is, the market is much smaller for this equipment than for the standardized, high volume designs.

Now let's address the area of field reliability. Our attitudes on reliability and our specifications themselves must change to encompass all types of field failures. In addition, we can replace much of the paper work in this area with more field and flight testing.

Also, I believe industry and the DoD must be more innovative in technical and operational test programs which can be utilized to find likely "field failures," and fix these before production is decided on. Random parts failures are not the whole story—but that's mainly what we specify and test today. Actual maintenance actions in the field are frequently treated by our reliability people as *nonrelevant* failures. But their cost in terms of maintenance time and lost systems availability is critical.

The field environment is a "dirty" one, the maintenance conditions are not ideal, but that is the world for which we must design and produce. That's where our equipment must work.

We are taking action to ensure that the supplier gets far greater feedback on his equipment's field experience. That will help, but we must offer more incentives to improve field reliability. We talk about, and we are concerned about, life-cycle costs, but we usually select suppliers on the basis of development or initial acquisition costs.

One answer to the life-cycle cost question is that we may find it advantageous more frequently to pay industry for a warranty of the equipment in the field—at least, in the early years of a system's deployment.

The developer has designed his equipment for a certain field reliability; if he becomes the producer, he should stand behind it. The warranty would be similar to that given by suppliers of commercial avionics equipment.

One form of this warranty could be a maintenance contract under which equipment is kept working and available for an annual fee. Perhaps a field reliability warranty would provide the necessary incentive to industry to reduce the causes of field failures—and to do it during the design phase, rather than later.

In addition, we are looking at the total lifetime costs of our equipment, and are now embarking on procurements which address directly the life-cycle cost concept. Again, the intent is to *design* for low acquisition cost and low support costs.

In summary, ladies and gentlemen, we must change the objectives of the R&D community, from the overriding emphasis on improving the state-of-the-art in performance, to an emphasis on *quality* equipment having an *acceptable* performance for an *affordable* cost.

The Office of the Secretary of Defense and the Services are looking across the whole of DoD management, from requirements to logistics, from accounting to training, and we think industry must take the same kind of broad look at its management. The change must go across the complete organization, not just a single program.

Design teams must be "driven" by needed functions, production cost and field reliability. Production teams must participate early in a program, before the design is frozen. "Support" functions must shrink. If we request unnecessary items, tell us. The data packages must be drastically reduced. More extensive field testing must replace some of the data packages, and overhead, too, must go down.

We recognize that it has often been our fault for asking for too much performance. Sometimes it has been our fault for accepting the high prices and the poor field reliability. But it has been your fault for making reliability and cost claims on which you could not deliver.

To attain our objectives, we must also establish and employ the necessary management incentives for industry. We will use more Cost Plus Award Fee contracts. We will reward contractors who give us quality, on-time deliveries, and agreed-to costs, and penalize those who do not.

A greater degree of profit determination will have to be made after completion of appropriate portions of the contracts in order for us to be able to reward the efficient and penalize the inefficient.

Now, we have a new game in town and you better believe it! The Congress knows it, and so does DoD management.

You are probably thinking, "we know it too—but the middle management in the DoD is still doing business as usual, and those at the ECOM (Electronics Command), ESD (Electronics Systems Division of the Air Force Systems Command), NAVELEX (Naval Electronic Systems Command), and the rest, haven't gotten the word." Well, they are getting it; and they will be getting more of it! We are aware that the need must be felt by the people who actually develop the technical requirements, write the specs, and procure the equipment. That is where the change has to take place. We recognize it, and all the military and the civilian heads of the DoD are working on it.

In each new procurement, we will apply these principles. If institutional changes are required, they will be made. I don't believe in just issuing a Directive—that's not enough. Middle management in the DoD and industry must first understand our problems and the nature of our planned solutions. We will be asking for help from industry, and we expect you to respond.

Today's electronic equipment is just too expensive. If we don't make changes that will increase productivity, the next generation systems will again cost twice as much. Because of this, most of them won't go into production and our security will suffer.

Electronics is an area of rapidly evolving technology. We can see places where improvements of a factor of 2 or 10 or even 100 can be made, not only in performance but in cost and quality. Therefore, I am convinced that over-all improvements of at least 2 to 1 can be realized.

With a 2 to 1 improvement in our productivity, and even with a constant defense budget, we will be able to afford to buy enough weapons to maintain an effective defense posture.

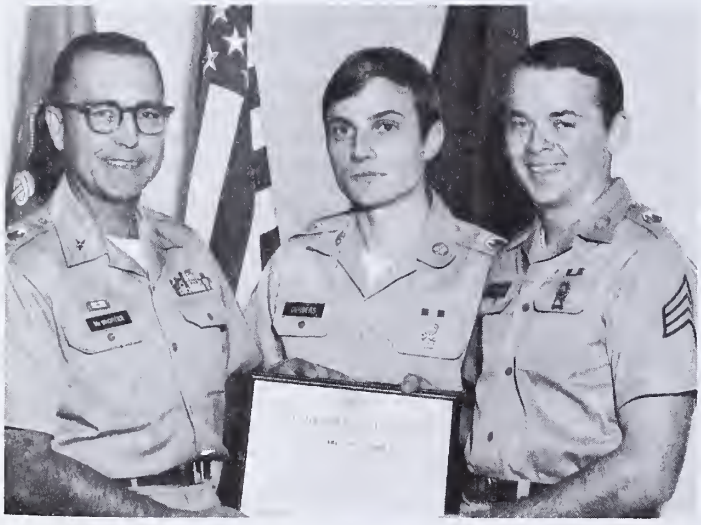
The key to implementing these new concepts lies in government and industry management. We must demand more discipline on *both* sides—discipline controlling costs; discipline controlling reliability; discipline familiar to the commercial marketplace, where those who can't perform drop out; and discipline governing that ever present human frailty of fiddling with the contract to try acquiring those last few percentage points of performance.

Ladies and gentlemen, what we are talking about is our nation's defense, our peoples' safety and the maintenance of Realistic Deterrence as we move toward the President's goal of a generation of peace. And those things demand our best efforts.

Career Programs . . .

2 Natick EM Win Commander's Military Awards

Two enrollees in the Army Scientific and Engineering Program for Enlisted Men were honored recently for outstanding achievements with presentation of the Commander's Military Awards at the U.S. Army Natick (Mass.) Laboratories.



NATICK LABORATORIES Commander BG John C. McWhorter honors SP4 Clifford Gerbers (c.) and SGT Carl W. Wickstrom.

SGT Carl W. Wickstrom, chemist, won the engineering award for his research in the field of food color. He also developed a training course for Food Chemistry Division personnel at Natick which earned him a Special Act or Service Award.

In addition, he developed two artificial color standards for objective grading of dehydrated potato granules and provided a stable color for compressed peas used for display.

SP4 Clifford Gerbers, a biological research assistant, was commended for redesigning equipment for taste adaptation studies. His science award citation states, in part: "Without his aid, new studies in olfactory response to mixtures and the design of simplified equipment for smell studies would have been impossible."

Wickstrom, from Owosso, Mich., earned a BS degree at the University of Michigan and his PhD at Massachusetts Institute of Technology. Gerbers graduated from Wisconsin State University at Oshkosh, where he received a BS degree in 1971. He is a native of De Pere, Wisc.

The awards were presented by BG John C. McWhorter Jr., commander of the Natick Laboratories.

The Army Scientific and Engineering Program for Enlisted Men has been highly attractive to university and college graduates since 1948, and has resulted in numerous significant R&D contributions (see May-June 1972 edition, pages 32–34). Limited to about 1,700 selectees, the program currently requires a master's degree or BS degree and work experience equivalence.

Many enrollees in programs have elected to continue as Army career scientists following discharge from military service.

CSC Studies New Job Classification System

Nearly 1.3 million U.S. Government white-collar positions at grades GS-1 through 15 will be affected by a project recently approved by the Civil Service Commission (CSC) to improve and modernize the present classification and evaluation system.

Based on recommendations of the Job Evaluation and Pay Review (Oliver) Task Force, authorized by Congress in 1970, the CSC plans to adopt the new system provided testing establishes its suitability. It combines the factor ranking method and benchmark positions for evaluation, instead of the existing system of comparing positions to classification standards.

Factor ranking is a technique of comparing a job to be evaluated with other jobs by deriving a composite rating of certain factors of the job. Rating is accomplished by comparing the factor of a job with a series of well-known benchmark jobs.

The basic factor ranking/benchmark position method has been used in evaluating Wage Grade blue-collar jobs for many years. The CSC believes that job classification through this method offers sufficient promise for General Schedule jobs to warrant a thorough test of its feasibility.

The testing project will be carried out by CSC's Test and Implementation Group in three phases and is expected to be completed in the fall of 1973.

In phase one, different panels made up of CSC and agency personnel specialists and managers will review a representative sampling of approximately 150 common white-collar jobs, from the beginning clerical worker to high levels of professional responsibility to select and test tentative factors and factor gradations.

The Commission will then analyze the results of the panel's studies to derive numerical weights for each of the factors to be used in measuring jobs. Factors which may be used are the difficulty of work, the amount of personal contacts required, knowledge, and others.

Conversion charts will be developed to translate the factor points into grades GS-1 through 15.

In phase two, the tentative system will be tested. Additional benchmark position descriptions will be prepared for use by agencies in evaluating sample jobs in their own agencies.

Finally, in phase three, CSC will review and evaluate all data received. If the tests prove successful, plans and timetables will be drawn up on methods of replacing the existing system.

When the new system is perfected and adopted, it is expected that managers, supervisors, employes and employe representatives will understand properly the job evaluation process and the basis for classification decisions.

Engineers Corps Architect Wins SARS Fellowship

Willis J. Hartman

Under a Secretary of the Army Research and Study (SARS) Fellowship Program to enhance development of civilian employes whose records indicate outstanding potential for future service to the Army, Willis J. Hartman has begun a one-year project.

Employed as a staff landscape architect in the Directorate of Civil Works, Office of the Chief of Engineers, Department of the Army, he is attending Pennsylvania State University to obtain a master's degree in environmental pollution control technology.

His studies and research will be devoted to the appraisal of the impact that on-land waste water disposal methods have on the environment. The evaluation will involve engineering, biology, agronomy, sociology, psychology, geography, geology, hydrology, botany, agriculture, landscape architecture, ecology of flora, fauna and man, and water ecosystems.

A basic objective will be identification and development of practical methods, criteria and guidance in determining the best physical siting for on-land disposal areas for waste water—suitable for environmental constraints of society as well as engineering design requirements.

Hartman has a BS degree in landscape architecture from Texas A&M University and has attended the U.S. Department of Agriculture Graduate School, Washington, D.C. He has served with the U.S. Army Corps of Engineers since 1955. In 1967–68 he was self-employed until he returned to duty in the Office of the Chief of Engineers.

Selection for the SARS Fellowship was based on Hartman's record of service with the Corps of Engineers, including extensive resource planning and the application design principles in solving complex and controversial problems of water resources planning in "a highly professional manner."

He has written or supervised numerous technical and policy memoranda published as engineering design manuals. Recently he prepared policy and guidance for a manual on "Landscape Planting at Floodwalls, Levees and Embankment Dams." He is registered as a professional landscape architect in Ohio and Maryland, and is a member of the American Society of Landscape Architects.

Women in Army Science . . .

Top Ranking Physician Named 'Woman of the Year'

COL (Dr.) Clotilde D. Bowen, U.S. Army Medical Corps, received the 1972 "Woman of the Year" Award from the Business and Professional Women's Club of Denver, Colo., Oct. 21.

Dr. Bowen is the highest ranking woman physician in the Army. She has other "firsts" to her record, including being the first black woman to earn a medical degree at Ohio State University; first woman to serve a residency at Tri-boro Hospital, Jamaica, N.Y., and first black woman psychiatrist in the Armed Forces.

Dr. Bowen has been chief of psychiatry at Fitzsimons General Hospital in Denver since August 1971, when she returned from a year in Vietnam. She was among the early physicians to take a special interest in drug abuse in the Far East. Much of her military career has been devoted to alerting the Armed Services to the hazards of alcohol abuse.

The 49-year-old doctor says that the discrimination she has faced occasionally throughout her life has been more because of her sex than her race, possibly because medicine has traditionally been a man's field.

Dr. Bowen is a Diplomate of the American Board of Psychiatry and Neurology and a member of the American Psychiatric Association, the American Medical Association, New York Academy of Sciences and the Colorado Psychiatric Society. She holds an appointment as an associate clinical professor of psychiatry at the University of Colorado School of Medicine, and participates in the teaching program of first-year residents of the school.

COL (Dr.) Clotilde D. Bowen

Among Dr. Bowen's other honors are the Achievement Award of the National Association of Negro Business and Professional Women's Clubs, Inc., the DeHaven-Hinson Award from the National Medical Association, and Alumni Achievement Award from Ohio State University College of Medicine.

AVSCOM Woman Selected To Receive Gas Engine Training

Adding another "first" to her list of accomplishments, Mrs. Geraldine Hillburger, of the U.S. Army Aviation Systems Command (AVSCOM), St. Louis, Mo., recently became the first woman to take the Lycoming Co.'s gas turbine engine maintenance course.

Completing the one-week course with six other Department of the Army personnel, Mrs. Hillburger will incorporate this training in her work as an aerospace quality assurance specialist (GS-12 rating) in the Plans and Programs Analysis Division, Product Assurance Directorate.

Even in that directorate she is the only woman among 140 men. Mrs. Hillburger has complete charge of developing product assurance plans for the whole life cycle of any new Army aviation program as they relate to all tests regarding reliability, maintainability, quality and product assessment.

She has been in quality engineering work since 1946, in government projects work with various industries for 18 years, and an AVSCOM staff member since 1967.

During this 26-year career, Mrs. Hillburger has taken many special training courses. Although in every job she has been the only woman among many men, Mrs. Hillburger explained that she has never been subjected to discrimination because of her sex.

"As long as a woman is well trained for her work," she said, "is truly willing to work hard but knows her physical limitations, and knows where she has to rely on men, she will receive fair treatment and fine cooperation from her fellow workers and superiors."

Mrs. Geraldine Hillburger

MICOM Designates First Female Missile Technician

Breaching another male barrier, Miss Delois Thomas is the first woman to be employed as a missile maintenance technician at the U.S. Army Missile Command (MICOM), Redstone Arsenal, Ala. She is believed the first in the entire Army.

Currently enrolled in a Redeye course at the Missile and Munitions Center and School, Miss Thomas recently completed the basic electronics course as a first step to familiarity with all aspects of the air defense missiles she will help to maintain.

When this training is finished, she will need to keep a bag packed for travel since missile maintenance technicians go many places around the world to service missile systems wherever they are deployed.

The chief instructor for the course Miss Thomas is now taking is also a woman, Margaret Morgan, who has been in the branch six years.

The two women have a common background, having taught high school mathematics. Miss Thomas graduated from Prairie View Agricultural and Mechanical College in Texas to become a teacher. Miss Morgan received a master's degree in mathematics from Birmingham Southern.

Before signing on as an instructor trainee at Redstone, Miss Morgan spent three years in the Peace Corps teaching mathematics and English in Ethiopia.

Miss Thomas' switch from education to Army missiles was almost accidental. A friend persuaded her to talk to an Army Materiel Command (AMC) personnel specialist from Denver, Colo. She interned at Red River Arsenal, then served two years at the U.S. Army Mobility Equipment Command.

A reduction in force placed her on the excess list so the managers of the AMC program cast about to find her a job at another commodity command. They reasoned her training and education could be used in the missile maintenance program so she was again transferred—to MICOM.

Through all the challenges that lead her to her present position, she said she kept her family's slogan in mind: "Give out but don't give up." She explained, "If you give out, you can rest. If you give up, you're finished."

She may be the most style-conscious of MICOM's maintenance technicians, for she sews and styles hair. And just to relax she frequently takes out her old math books to work problems.

TRAINING to be a maintenance technician, Delois Thomas (right) runs a missile test with the guidance of Margaret Morgan, chief instructor for the Redeye course at the Missile and Munitions Center and School, Army Missile Command.

Personnel Actions...

Sisson Named Edgewood Deputy Commander

Edgewood Arsenal's new deputy commanding officer is COL George D. Sisson Jr., who had served as director of the arsenal's Manufacturing Technology Directorate since Sept. 1971.

COL Sisson, who served as director of Plans and Analysis for the Army Munitions Command, Dover, N.J., until he reported for duty at Edgewood, succeeds COL George A. Lynn, now commander of Pine Bluff (Ark.) Arsenal.

A native of Tarrant, Ala., COL Sisson graduated with a BS degree in general education from the University of Omaha in 1960. He received a master's degree in business administration from the University of Alabama in 1969.

He entered the Army in 1947 and served two years as an enlisted man. In July 1949 he was commissioned as a second lieutenant in the Chemical Corps upon graduating from Officer Candidate School, Fort Riley, Kans.

COL George D. Sisson Jr.

COL Sisson completed a year's study at the Command and General Staff College, Fort Leavenworth, Kans., before serving (1964-67) as chief of both the Academic Operations and the Management Logistics Division at the Chemical School, Fort McClellan, Ala.

After 1967-69 graduate study at the University of Alabama, he was assigned as chief, Operations Division, HQ U.S. Army Vietnam.

Hansen Heads NLABS Life Support Lab

Appointment of John V. E. Hansen as director of the Personal Life Support Equipment Laboratory of the U.S. Army Natick (Mass.) Laboratories was announced Oct. 27. Dr. Stephen J. Kennedy, who served in this capacity for 30 years, retired but is still a consultant to the technical director.

John V. E. Hansen

Hansen is now responsible for research, development and engineering programs for clothing and equipment to protect military personnel in all types of environment in which American Soldiers may have to serve.

Formerly a division manager with Norton Co., Worcester, Mass., he directed the program leading to the first commercial production of light-weight boron carbide ceramic armor for personnel, aircraft and small craft. He has a patent for one personnel armor system and recently directed programs involving use of advanced ceramics in automobiles and gas turbines.

Hansen was earlier director of government contracts and marketing for the National Research Corp., Cambridge, Mass. He has served with Allied Chemical and Dye Corp. in the textile field, and Jackson and Moreland Consulting Engineers in Boston.

A registered professional engineer, he is a member of the American Ordnance Association, American Institute of Astronautics and Aeronautics, and American Ceramic Society. Author of numerous articles and technical papers on subjects ranging from government procurement to materials research, he is a past president and a founder of the Society of Technical Writers.

Hansen received a degree as bachelor of chemical engineering at Polytechnic Institute of Brooklyn and did graduate work there, at Boston University and at Northeastern University.

Howard Joins USASCS as Product Manager

COL G. B. Howard is the new product manager of the Computerized Training System (CTS) prototype at the Army Signal Center and School, Fort Monmouth, N.J.

COL G. B. Howard

He brings to this major 4-year project a diverse Signal background and nearly 27 years of Army service, including a recently completed tour of duty as chief, 4th Signal Group, Mannheim, Germany.

A graduate of the Army War College, he had successive assignments in recent years at the Signal School, Fort Monmouth, N.J., and the Southwestern Signal School in San Luis Obispo, Calif.

In 1966, following three years on the faculty of the Command and General Staff College, he was assigned as chief of the Research Management Division, Communications-Electronics Office, and later during a one-year tour with the U.S. Army, Vietnam, as project officer, Command Management Center.

COL Howard then spent two years at the U.S. Army Artillery School, Fort Sill, Okla., as deputy director of the Communications-Electronics Department.

His decorations include the Legion of Merit with Oak Leaf Cluster and the Joint Service Commendation Medal with Oak Leaf Cluster. He also holds the Joint Chiefs of Staff Badge for his service in 1969-70 as staff planner, U.S. Delegation to the NATO Military Committee, Brussels, Belgium.

OTSG Appoints Castellot to Drug Abuse Office

COL (Dr.) John J. Castellot, Sr. has joined the staff of the Drug Abuse Office, Directorate of Plans, Supply and Operations, Office of the Army Surgeon General. His previous assignment was director of the Drug Operation Center and Medical Consultant to HQ, U.S. Army Health Services Group, Vietnam.

He received his commission in the Army Medical Corps in 1954, and took a rotating internship at Fitzsimons General Hospital. His scholastic qualifications include a bachelor's degree and an MD from the University of Rochester.

From 1967 to 1971, COL Castellot was assistant chief, Department of Hospital Clinics, Walter Reed General Hospital. He has also served as chief of Medical Service, U.S. Army Hospital, Berlin, and as assistant chief of Medical Services, U.S. Army Hospital in Heidelberg, Germany.

His military awards and decorations include the Legion of Merit, Meritorious Service Medal and the Army Commendation Medal.

Cadigan Heads Medical Research at USAMRDC

COL (Dr.) Francis C. Cadigan Jr., MC, formerly commander of the U.S. Army Medical Research Unit, Malaysia, is the new director of Medical Research, U.S. Army Medical R&D Command (USAMRDC), Office of the Army Surgeon General.

Much of his 13-year military career has been in medical research at Walter Reed Army Institute of Research in Washington, D.C., and as WRAIR representative on various foreign assignments.

COL Cadigan has AB and MS degrees from Boston College, an MD from Tufts University School of Medicine and a master's degree in public health from Johns Hopkins University. Since 1956 he has had approximately 50 articles published in medical journals.

ECOM Assigns Banister as Project Manager

Grady H. Banister Jr. has assumed duties as project manager of the Army Tactical Data Systems (ARTADS), U.S. Army Electronics Command, and also will continue to serve as an Army principal adviser on all aspects of tactical data systems development.

Banister has a bachelor's degree from the United States Military Academy, West Point, N.Y., and a master's degree in electrical and industrial engineering from Stanford University.

He served 10 years in the U.S. Army prior to entering private industry, where he has held several key positions, and has also been a private consultant in data processing.

Pattillo Takes Yuma Proving Ground Command

COL Hugh H. Pattillo

COL Hugh H. Pattillo, previously chief of the Infantry Branch, Office of Personnel Operations, Department of the Army, is the new commander of Yuma Proving Ground, Ariz.

A 1951 graduate of the U.S. Military Academy, he has served in key command and staff positions in the United States and overseas. After earning a master's degree in physics from the University of Virginia in 1959, he was assigned to the Missiles and Space Division, Office of the Chief of Research and Development (OCRD), Washington, D.C.

Graduated from the Command and General Staff College in 1963, COL Pattillo then became the executive officer/senior aide to the commander, Allied Land Forces Southeastern Europe, Izmir, Turkey.

Graduation from the Industrial College of the Armed Forces in 1968 was followed by 19 months service in Vietnam—first as a project officer with the Army Concept Team in Vietnam (ACTIV), then as executive officer to the Deputy Chief of Staff (Plans and Operations) at Headquarters, USARV, and finally as a brigade commander with the 1st Infantry Division.

His decorations and awards include the Silver Star, Legion of Merit with OLC, Distinguished Flying Cross, Bronze Star with 4 OLCs, Air Medal with 12 OLCs, Army Commendation Medal with OLC, and the Combat Infantry Badge with second award.

Bryson Appointed CDEC Scientific Adviser

Dr. Marion Bryson, who for almost a decade functioned as one of the "prime movers" in planning and preparing for the annual Operations Research Symposium sponsored by the Army Chief of Research and Development, has accepted a key R&D assignment in California.

BG Ray Ochs, CG of the U.S. Army Combat Developments Experimentation Command, Fort Ord, Calif., announced that Dr. Bryson has succeeded Walter Hollis as scientific adviser of the CDEC. Hollis is a student at the National War College, Washington, D.C.

Dr. Bryson has served in recent years as technical director of the Systems Analysis Group (SAG) with the Combat Developments Command headquarters at Fort Belvoir, Va. He was in charge of the assignment, conduct and approval of SAG technical study projects supporting the CDC, and also was the principal contact with the scientific, professional and academic communities.

A former Duke University Medical School professor, he also performed research in mathematics, statistics, and operations research techniques. While at Duke he worked under contract with the Army Research Office—Durham. During the period of 1963-71, he served as program chairman and then as general chairman of the Operations Research Symposia.

Dr. Bryson has published technical articles in numerous American and British journals on operations research techniques, medical statistics, and sampling methods.

Dr. Marion Bryson

OCRD Announces New Officer Assignments

New officers recently assigned to the Office of the Chief of Research and Development (OCRD), Department of the Army, include *LTC Harl G. Graham,* a staff officer with the Air Defense Team, Missiles and Special Weapons Division.

In 1971-72 he served at Fort Bragg, N.C., first as CO, 42d Civil Affairs Co., and later as executive officer and deputy CO, 95th Civil Affairs Group. During 1967-71 he was associate professor, Department of Electrical Engineering, U.S. Military Academy, and later assistant chief of staff, G-5 and chief of Civil Military Operations, Vietnam. He was a guided missiles systems staff officer G-3, Plans Division, U.S. Army Air Defense Command (1962-64).

LTC Graham has a 1953 BS degree from the U.S. Military Academy and a 1967 MS degree in electronic engineering from the University of Arizona. He is an Army Command and General Staff College graduate.

His military honors include the Legion of Merit (LM) and the Army Commendation Medal (ARCOM) with two Oak Leaf Clusters (OLC).

LTC George S. Kourakos is a staff officer with the Science and Technology Division, after serving as regimental senior advisor, 54th Army, Vietnam, Infantry Regiment.

During 1968-72 he was operations officer, J-3, Office of the Joint Chiefs of Staff, Southeast Asia Division, OCRD. In 1966-67 he served as deputy G-2 and assistant chief of staff G-2, 1st Infantry Division, Vietnam.

He has a 1954 BS degree from the USMA and a 1962 MS degree in electrical engineering from the Georgia Institute of Technology. He is a graduate of the Army Command and General Staff College.

His military honors include the LM, Bronze Star Medal (BSM) with two OLC, Meritorious Service Medal (MSM), Air Medal (AM) and the ARCOM with OLC.

LT Henry D. Barton is a staff scientist with the Motivation and Training Laboratory. During 1969-70 he was a research associate for the Ford Foundation in Tanzania, East Africa.

His academic credentials include a 1966 BA degree in liberal arts and a 1968 MA degree in linguistics both from the University of Texas at Austin. He is scheduled to receive his PhD in linguistics this month. He is a recipient of the ARCOM and is coauthor of *Language in Tanzania* (pending publication).

MAJ Leon K. Moraski is a staff officer in the Combat Materiel Division following a tour as project officer with the Engineer Agency, U.S. Army Combat Developments Command.

In 1969-70 he served with the 25th Infantry Division in Vietnam, first with the Division Support Command staff and later as executive officer, 65th Engineer Battalion. He was assistant professor, Department of Earth, Space and Graphic Sciences at the USMA (1967-69), following a 1965-66 tour as operations officer and team chief on the Sequential Collation of Range Project, U.S. Army Map Service, U.S. Army Pacific.

MAJ Moraski has a 1959 BS degree from the USMA and a 1965 MS degree in astronautics space facilities from the U.S. Air Force Institute of Technology. Among his military decorations are the Soldier's Medal (SM), BSM (with three OLC), AM and the ARCOM (with OLC).

MERDC Assigns Osteen as Deputy Chief of MTD

Deputy chief of the Mechanical Technology Department, U.S. Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va., is the new title of Lemuel L. Osteen.

During 20 years civilian experience at the MERDC, he served most recently as chairman of the Source Selection Evaluation Board for the Family of Military Engineer Construction Equipment (FAMECE). In his new assignment he is responsible for research, development and engineering of construction, earth-moving and materials-handling equipment, environmental equipment and fuels-handling equipment.

A graduate of North Carolina State University with a BS degree in general engineering, Osteen served in the Army under the Army Scientific and Engineering Program for Enlisted Men at Fort Belvoir, Va. He has earned several "Outstanding" performance ratings and a Department of the Army Certificate of Appreciation.

People in Perspective . . .

Edgewood Mathematician Triumphs Over Handicap of Poliomyelitis

Ronald O. Pennsyle, a mathematician at Edgewood Arsenal, Md., is an outstanding example of the rewarding results when employers respond to the appeal, "Hire the Handicapped."

Paralyzed since 1956, when an attack of poliomyelitis left him with the use of only his left hand and wrist, Pennsyle has received numerous awards during his eight years of U.S. Civil Service employment.

Since 1964, he has gone through a progression of jobs at Edgewood Arsenal. In January 1972 he was promoted to GS-12 in the Engineering Analysis Branch, Directorate of Development and Engineering.

When stricken with the disease 16 years ago, Pennsyle was an undergraduate student at North Carolina State University (NCSU) in Raleigh. Although confined to a wheelchair after the attack, he returned to NCSU and received a BS degree in chemical engineering in 1963. He remained to earn a master's degree in applied mathematics in 1964.

Pennsyle now conducts mathematical analyses used to evaluate the capabilities of conventional and newly conceived chemical weapons systems. An elevated desk and an electronic calculator with easily depressed keys are his only major on-the-job adaptations.

He is driven to and from work by his mother, Mrs. Margaret S. Pennsyle, who is also employed at Edgewood. A special portable runway permits him to enter and leave his double-door club wagon in his wheelchair.

Pennsyle is Edgewood Arsenal's nominee for the "Outstanding Handicapped Federal Employe of the Year" Award. The letter of nomination notes that he is applying abstract mathematics principles and concepts, requiring exceptional ingenuity and creativity, to solve a variety of complex problems.

Dr. Joseph Epstein, chief of the Defensive Research Branch in the Chemical Laboratory, believes the severity of Pennsyle's handicap has stimulated rather than hindered professional development.

"He is an outstanding example to all employers of the rewards and profits of hiring handicapped people," Dr. Epstein said.

Ronald O. Pennsyle

Another employe, who remembers him when he was first appointed to Civil Service status, is Mrs. Riley G. Cornett who said: "His enthusiasm for his work was contagious and the employes around him were caught up in the fervor."

Pennsyle received a Citation of Meritorious Service from the President's Committee on Employment of the Handicapped in November 1966. A month later he received the Award of Merit from Maryland Governor Tawes' Committee to Promote Employment for the Handicapped.

ACLAM Certifies Edgewood Veterinarian Chief

Recognized for his professional qualifications, CPT William T. Watson of Edgewood Arsenal, Md., was certified recently as a Diplomate by the American College of Laboratory Animal Medicine (ACLAM).

Chief of the Veterinary Medicine and Surgery Branch of Edgewood's Biomedical Laboratory, he was certified after completing the prerequisite U.S. Army Laboratory Animal Medicine Preceptorship Training Program. He is now qualified to perform any assignment in laboratory animal medicine.

CPT William T. Watson

Since its founding in 1957, ACLAM has certified less than 200 veterinarians as Diplomates. Only professional veterinary specialists who have six years of laboratory animal experience, demonstrate research capabilities, and have successfully completed a series of written, practical and oral examinations administered by the college are certified.

CPT Watson's principal research interest is infectious diseases of laboratory animals, especially encephalitozoonosis—a disease of the brain of rabbits and other animals.

A native of Rochelle, Ga., he received a doctor of veterinary medicine from Tuskegee Institute, Ala., in 1965, and master's degree in laboratory animal medicine from Ohio State University in 1971.

In addition to completing his preceptorship while serving at Edgewood Arsenal, he had a 1965-67 tour of duty at Walter Reed Army Institute of Research in Washington, D.C. He then served a year with the 4th Medical Detachment in Vietnam.

His military honors include the Bronze Star Medal, Army Commendation Medal and the Vietnam Service and Campaign Medals.

CPT Watson is a member of the American Veterinary Medical Association, and the American Association for Laboratory Animal Science.

Faith in American Dream Leads To TACOM Employe's Success

Proving that the American dream still holds promise of fulfillment, Angelo Costan, who came to this country in 1952, has risen from trainee to GS-14 in less than 11 years at the U.S. Army Tank-Automotive Command (TACOM), Warren, Mich.

Born in Alexandria, Egypt, as a Greek citizen, Costan spoke five languages when he arrived in the United States at the age of 17.

After attending Northwestern High School in Detroit, Mich., he worked his way through Wayne State University, enlisted in the Air Force Reserve, and was called to active duty during the historic Cuban Crisis.

In June 1960, he passed the Federal Service Entrance Examination (FSEE), and two months later became an ADP (automatic data processing) trainee. From on-the-job training through being a senior analyst, Costan excelled in his work, and in April 1971 became a GS-14 division chief.

However, Costan continues to look forward to more ADP challenges at TACOM.

Watervliet Engineer Selected For Army Long-Term Training

Patrick M. Vottis, a mechanical engineer at the Watervliet (N.Y.) Arsenal, has been chosen for a year of graduate studies at Rensselaer Polytechnic Institute through the Army's Long Term Training and Education of Civilian Employes Program.

Vottis is employed in the Systems Engineering Division of the arsenal's Benet Weapons Laboratory. His studies will lead to a master's degree in mechanical engineering and mechanics, specifically in heat transfer and propulsion. He has a 1961 BS degree in physics from RPI and has served with the arsenal staff since 1964.

THE TRUE JOY OF LIVING . . .

comes from really accenting the positive

Accenting the positive is a way of life for Cheryl Lee Maloney, a U.S. Army Computer Systems Command employe who declines to consider herself handicapped because she was born without arms. She prefers to regard that condition as a stimulus to achievement.

Cheryl is regarded by supervisors as a truly outstanding intern in the automatic data processing program at HQ USACSC, Fort Belvoir, Va. She neither expects nor receives preferential treatment.

Not only does Miss Maloney perform dexterously as a computer programer; she skis, swims, goes bowling and drives her specially equipped convertible. People who open doors or hold chairs for her rile her dander, to the point she could kick them. Sometimes she does, but only by way of jesting protest.

A native Pennsylvanian, she was entitled to a full scholarship under Pennsylvania law as a handicapped person, but she lost patience with officials who told her that she would be unable to handle computers.

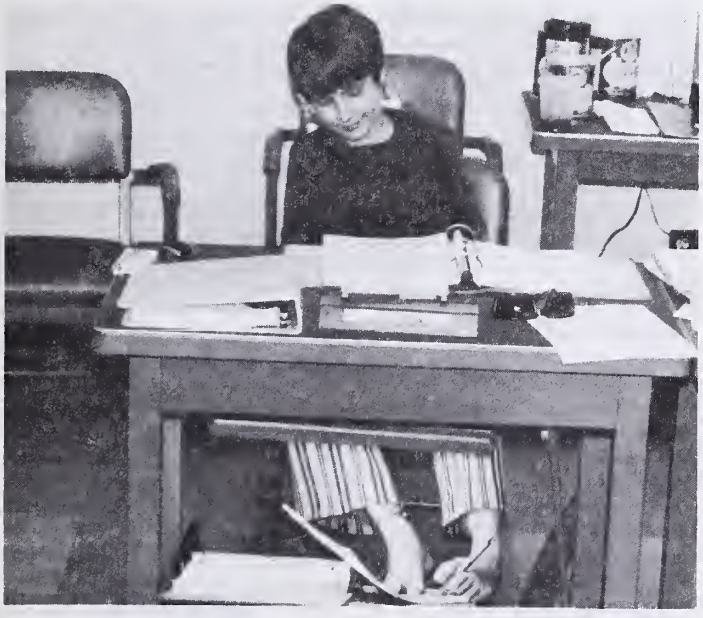
Selected from more than 300 punch card operators who applied nationwide for the USACSC automatic data processing intern course, she was the only one from Tobyhanna (Pa.) Army Depot chosen to fill one of 20 openings. Her advancement has relieved her of the need to operate ADP equipment. Upon graduating from the first phase of the program in November, she will be transferred to a USACSC Field Support Group in Texas—her choice—and be promoted from GS-5 to GS-7 next May as a programer.

Upon graduating from the intern program in May 1974, she will be promoted again to GS-9 and may be eligible for another transfer.

Miss Maloney has received several Army Incentive Awards Program citations for achievement and has been nominated by the USACSC for the Army's outstanding Handicapped Employe of the Year award. She says that she entered the ADP program because it was a challenge and she likes challenges. A proud and amazing young lady, she seems to thrive on them in a way inspiring to coworkers.

Hunting for underground "treasure" is a hobby of Louis Markey, a supply specialist at Picatinny Arsenal, Dover, N.J., who has exhumed four jars of coins (over $114), a lead doll, horseshoes, old railroad spikes, and many other metallic objects.

Using a Detecto, a device that acts somewhat like a mine detector,



Cheryl Lee Maloney

Picatinny Employe Hunts Treasure as Hobby

he has probed around playgrounds, parks, school yards and old abandoned houses in search of buried objects of value.

When he vacations in Melbourne, Fla., Detecto is his constant companion. Emitting a bird-like sound when it approaches a metal object, the Decto enables Markey to discover hidden treasure on beaches.

Included in his coin collection thus far are copper pennies dating back to 1819 and old Mexican coins. With his "Midas touch," Markey is also contributing to the ecology by picking up old cans and metal junk for disposal in litter baskets. As he puts it, it's not how much you find but the thrill of finding it that makes his hobby so interesting.

Health Physicist Lives in Steady Threat of Danger

Fathoming the most outlandish and dangerous circumstances fear can conjure is an obsession as well as a profession for Harry C. Harrison; in fact, when he leaves the job to go home at night, his worry almost becomes a hobby.

Harry C. Harrison

Harrison is the health physicist for the Nuclear Weapons Effect Laboratory at White Sands (N. Mex.) Missile Range—charged with insuring the safe study of radioactive material by preparing adequate precautionary measures. He is the only certified health physicist in the 15 installations of the U.S. Army Test and Evaluation Command.

One of less than a dozen certified health physicists in the U.S. Army, the 42-year-old native of El Paso has been at WSMR, the nation's only overland missile test range, since 1964. Only once has he witnessed an emergency.

"That happened in 1965," he recalls, "and it was actually a blessing because it told us what safety precautions were most effective. There were no injuries and no damage. The nuclear reactor's burst was a little bigger than we had expected and it tripped our safety devices."

Thousands of bursts have taken place since 1965 without incident. Bursts involve subjecting missile components to nuclear radiation. Besides anticipating the worst, Harrison makes sure radiation is contained and that devices accurately determine degree and type of contamination.

For two years, this graduate of the University of Texas has joined with area industries, as a hobby, in developing plans to prevent radiation injury and damage. In 1970 he helped with the Southwestern Nuclear Medical Group's radiation surveys in El Paso. He also conducted a survey to make sure there was no radiation leakage in the X-ray rooms at Las Cruces' new Memorial Hospital.

Medical facilities usually have the most use for radioactive materials. Because these materials have short life-spans for utility and must be shipped by air, Harrison becomes involved in air freight.

Regional and national publications recently called attention to dangers of shipping improperly packed or labeled radioactive materials. Federal authorities have fewer than 50 inspectors to monitor shipping of all types, by all modes all over the United States.

The White Sands employe has counselled each airline at El Paso International Airport on methods to prevent contamination. He also stands ready to assist local officials should faulty packaging cause leakage of any radioactive substance.

Harrison envisions his role, in such circumstance, as determing what type and how much material is causing harm and prescribing safety procedures to protect the public. He has assured civilian officials that any radioactive freight material going from WSMR is properly packaged and labeled.

In addition, he helps the Bureau of Reclamation in its endeavor to advise farmers on irrigation necessities. Harrison can tell the bureau if its thermo-neutron detectors are leaking. The detectors are used to measure percentage of water in soil.

"I'm not very large on social organizations and clubs," he says, "so I figure this public safety hobby is a unique opportunity to make my contribution to the area in which I live."

Harrison's worrisome work is sometimes interrupted by humor. He tells of the time a woman called, asking him to get some radium.

"Why?" he asked.

"Because I have a hard time finding my glasses at night and if I could put the same stuff on them that's on watches that illuminate at night, then I could find my glasses better. And if it works really good, you and I could patent it."

The shocked Harrison quickly indicated to the lady that the illumination on her watch, if placed on the frames of her glasses, would be quite harmful to her eyes. She concluded:

"I guess it wouldn't be good on contact lenses, either."

Awards . . .

BRL Scientist Cited for Ballistics Achievements

BRL Deputy Commander COL Thomas R. Ostrom presents Kent Award certificate to Leonard C. MacAllister, a physical science administrator with BRL at Aberdeen Proving Ground, Md.

The most prestigious annual award of the Exterior Ballistics Laboratory of the Ballistic Research Laboratories—the Robert Harrington Kent plaque and lapel pin with a Certificate of Achievement—was presented recently to Leonard C. MacAllister.

Initiated in 1957, the award honors BRL's most prominent scientific leader and gives recognition for outstanding professional achievement in science or engineering.

MacAllister, a physical science administrator with BRL at Aberdeen Proving Ground, Md., was selected for his contributions to the design of Army munitions and for his "great influence on the growth of exterior ballistics knowledge." The award citation also notes his contributions to the Department of Defense and the Tripartitite Technical Cooperation Program.

COL Thomas R. Ostrom, BRL deputy commander, made the presentation and Dr. Curtis W. Lampson, a former BRL director, was the guest speaker at ceremonies attended by BRL personnel.

MacAllister obtained a bachelor's degree in aeronautical engineering at Rensselaer Polytechnic Institute in 1947 and continued his studies there to receive a master's in 1949. In July 1949 he joined the BRL Free Flight Aerodynamics Branch. In 1970 he became chief of the branch, which has more than 40 engineers and supporting personnel engaged in research on flight dynamics of missiles and shells.

AMMRC Employe Elected to Institute of Ceramics

Dr. Sunil Dutta of the Ceramics Research Division at the Army Materials and Mechanics Research Center in Watertown, Mass., has been elected a Fellow of the Institute of Ceramics at Stoke-on-Trent, the primary professional society in England.

At the AMMRC he is engaged in research and development of lightweight ceramic materials for armor and other high-performance structural applications.

Known for his research on materials processing (solid-state sintering, hot pressing), Dr. Dutta began his AMMRC career in 1968 as a senior research ceramic engineer, following completion of postdoctoral courses at Lehigh University.

He has BS and MS degrees from the University of Calcutta, and a second MS degree and doctorate from the University of Sheffield, England. A member of the American Ceramic Society, Sigma Xi, the Institute of Ceramics, and the National Institute of Ceramic Engineers, he has authored 15 technical papers and has received a number of patent awards.

Dr. Sunil Dutta

IEEE Honors Harry Diamond Labs Man With Highest Annual Award for 1973

Selection of an Electronics Command scientist for one of the highest annual awards in the electronics industry, the 1973 Harry Diamond Award of the Institute of Electrical and Electronics Engineers, was announced recently by ECOM.

Dr. Harold Jacobs

Dr. Harold Jacobs, a senior research scientist and physicist in the Electronics Technology and Devices Laboratory, will be presented a $1,000 honorarium and Certificate of Achievement at the 1973 Northeast Electronics Research and Engineering meeting in Boston in November.

Named for the late Harry Diamond, founder of the Diamond Ordnance Fuze Laboratories in 1953, now the Harry Diamond Laboratories in Washington, D.C., the IEEE award was initiated 22 years ago. It gives recognition to a government researcher for an outstanding technical contribution and Dr. Jacobs is the sixth ECOM selectee.

Employed by ECOM since 1949, Dr. Jacobs has worked on electron tubes, solid-state devices, quantum electronics, millimeter wave devices and submillimeter lasers. He is the author of more than 500 publications in professional journals and has been awarded 20 patents.

Elected as an IEEE Fellow in 1967, he was awarded the Decoration for Exceptional Civilian Service in 1969 for work in semiconductor millimeter wave devices.

Dr. Jacobs is chairman and professor in the Electronics Engineering Department at Monmouth College, chairman of the IEEE Group IV Materials Committee, the Army member of the Special Group on Optical Masers sponsored by the Department of Defense, and was program chairman for the DoD Conference on Laser Technology in 1970.

'Should Cost' Pays Dividend to Edgewood Analyst

Winning citations and cash awards is becoming a habit with Robert N. Epperson, a management analyst at Edgewood Arsenal, Md.

Cited twice in less than 90 days, he recently received a $1,000 Special Act or Service Award for professional competence as a member of the management Should Cost Sub team at the Army Ammunition Plant, Radford, Va. He earlier received a Special Act or Service Award and $175 for contributing to a Should Cost study at Cornhusker Army Ammunition Plant, Nebr.

The term Should Cost denotes a technique in which all elements of a contractor's operations are examined in detail by a highly qualified team of Civil Service personnel to determine what products and materials manufactured for the federal government should cost.

In the Cornhusker assignment, Epperson was credited with analyzing the functions and staff structure of the contractor's industrial engineering department and support elements. His recommendations contributed to estimated first-year savings of more than $456,000.

Epperson's achievements in Should Cost analysis do not happen just by chance. He brings to his work 12 years of management engineering experience at Edgewood Arsenal since he received a BS degree in political science from Michigan State University in 1960.

Until 1967 he progressed in career-development positions in the arsenal's management and engineering offices. For the next three years he was a management analyst in the comptroller's Office at HQ Eighth U.S. Army, Seoul, Korea.

Since 1970 he has conducted studies relative to Edgewood Arsenal policies and procedures. He also assists in the administration of support services agreements with other DA activities.

Should-Cost analysis is an effective system for pricing a manufacturer's products in noncompetitive procurement, he says, in that "It develops a negotiation base which reflects what price could have been achieved in a competitive award."

Robert N. Epperson

Lessons Learned in 'Nam

132d Army Medical Detachment Applying Same Techniques in U.S. Crash Rescue

Lessons learned in combat in Vietnam in developing the highly skilled techniques of medical evacuation of the wounded for life-saving emergency treatment are being extended to Army aircraft crash rescue in the U.S.

Admittedly in its infancy, the developmental program has achieved improved proficiency, as demonstrated by the 132d Medical Detachment at Fort Bragg, N.C. The unit is one of four units in the United States that are the first to use helicopters in crash rescue operations.

Testing equipment and setting up its procedures in experimental operations, the 132d honed its two helicopter rescue crews to a fine edge until February 1972. Then actual rescue operations began as a supplement to ground fire-fighting, rescue equipment.

Because fire is a major hazard in aircraft crashes, the UH-1Hs are equipped with a fire-suppression kit, consisting of two 25-gallon tanks filled with a fire-fighting agent known as light water.

Hoses run from the tanks, set in the rear of the helicopter, to a metal boom that can be extended 16 feet in front of the chopper and turned 90 degrees to the right. Water is sprayed from a nozzle at the end of the boom. Bleed air pressure from the helicopter's engine is used to pump the water from the tanks to the nozzle.

Another part of the mission that has been developed is considered the most efficient way to rappel from a UH-1H helicopter. At first an aircraft floor anchoring device was used. With this method a man had to squat on the skid before rappeling, causing the pilot to have difficulty maintaining stability of the chopper.

Further experimentation led to the use of a rescue hoist which creates less turbulence for the pilot. Mounted on the side, and swinging out from the helicopter, the hoist is anchored above the rappeling man so that all he has to do is jump directly from the helicopter and start to the ground.

Under test at this time is a new lightweight asbestos suit designed for rescue operations in a burning aircraft area. Suits used in the past have been too heavy and cumbersome to allow free movement, but the new suits give the rescuers greater mobility and flexibility.

The time span for the rescue crew to scramble has been whittled down to less than two minutes. When a distress signal is given, the unit goes out to escort the aircraft back to home base. In the event of a crash, the crew is out and on the way to a hospital in 90 seconds.

From the time the helicopter descends to a crash scene, it takes about 15 seconds to rappel rescue specialists and clear a path through the fire. It then takes 30 to 45 seconds to accomplish the rescue. The medic administers aid and the chopper evacuates to the hospital.

Since beginning its actual service to Simmons Army Airfield at Fort Bragg in February 1972, the 132d has covered 18 precautionary emergency landings, four forced landings and, luckily, no crashes.

FIRE MEDIC rappels from UH-1D helicopter at scene of mock aircraft crash.

FIRE MEDICS enter mock crash area to retrieve any possible casualties as the UH-1D rescue helicopter, equipped with a Fire Suppression Kit, sprays a light-water solution on the flames to create a passageway.

FIRE MEDICS load a casualty aboard UH-1D helicopter at mock aircraft crash.